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THE MONIST

THE PROBLEM OF FREEDOM

I

PERHAPS the most obtrusive problem that has perplexed the mind of man, the profoundest contrast to oppress his spirit, has been that of his freedom in a Universe which seems so coldly impassive, if not indeed actively hostile. Here his most deeply rooted instincts have seemed too often to defy both reason and actual experience. Not only did he passionately desire freedom, but an intuition, imperative despite its vagueness, seemed to proclaim that he *was* free, and that the fetters of his thraldom were borne by one who was king in his own right. A king, but deposed and imprisoned; while some despot — Fate, Destiny, Karma—mocked his misery with an illusory liberty. The Greek, boldly claiming for himself a nature one with his gods', subjected even their caprice to the dark counsels of the unwed and unfathered Fates. Always, for him, "human life, even in its utmost strength and splendor, hangs on the edge of an abyss." [1] Ambition lured to its own defeat and final ruin; "when the gods intend to destroy a man they grant him his desire." [2] To the Hebrew, likewise, although moral perfection became a divine attribute, his God was Lord before he rose to Righteousness, and the poet of medi-

[1] Mackail, *Lectures on Greek Poetry*, p. 154.
[2] Thomson's rendering of Juvenal, *Greeks and Barbarians*, p. 107.

eval Puritanism has pictured the sad satellites of Satan who, at the dawn of creation,

> reasoned high
> Of Providence, Foreknowledge, Will and Fate—
> Fixed fate, free will, foreknowledge absolute—
> And found no end, in wandering mazes lost.

Nor has the modern mind really dispensed with these Fates of old; it has only renamed them, and has retained, with them, the eternal problem. As, for the ancient thinker, they became the daughters of Necessity,[3] so for us the Universe is the domain of Law—Heredity, Mechanism—however far-reaching and complex these may become. To man, Nature is ancestral; even "space-time" may be the primal fount whence springs all Reality.[4] To say the least, these fatalistic categories constitute the basis for the advance of modern thought along one main line of investigation. They lie at the root of the persistent attempts to reduce Biology to Chemistry, Chemistry to Physics, and both to Mathematics; efforts whose success thus far is the occasion for rejoicing to some, for regret or even despair to others. To many, this basis is one of bedrock; to others a mere quicksand or mirage; its future stability, or its transience, are both prophesied with equal assurance.

Evidently, then, the attitude which is taken at the outset to the principles and methods here involved is of fundamental importance. For—as has indeed already been implied—it determines in advance, if not completely at least very largely, the trend of all further investigation. It settles both the character of the final result for which we are searching and the direction taken at each step throughout the whole enquiry, and its results may be traced on both an individual and a universal scale; for, in accord mainly with the temperament of the student, it leads to his inclu-

[3] Plato, *Republic*, 617.
[4] Prof. Alexander, *Space, Time and Deity*.

sion within one or other of two great but, unfortunately, opposed, schools of thought whose controversy has agitated the long history of speculation and given rise to all the "isms" of Philosophy.

And so evenly balanced, in their truth and value, have proved to be the unquestionable results of each of these contending systems that the advance of knowledge, instead of following a straightforward path, has taken a course so tortuous that its disadvantages are compensated only by the added interest attending the uncertainty of future developments. Some relativists would compress universal change into a series of differential equations; to which certain philosophers retort that this procedure inevitably involves the primacy of mind. While some biologists would reduce vital processes to the chemical or even the physical category, others contend that neither physics nor chemistry suffices to explain the characteristic delicacy of response and co-ordination,—that if we must accept these mechanical sciences, then it can only be in the form of a *bio*-physics and a *bio*-chemistry. Psychologists express mental phenomena in tables and formulae; straightway others find unmistakable evidences of intelligence in the Protozoa. To the eugenist who would control heredity it is objected that the price of the elimination of insanity may be the loss of genius, and some ethicists accept—with sorrowful resignation or with joyous defiance, as the case may be—a spiritual world swayed by a hidden but inescapable determinism, while others subordinate this to a freedom which is too often miraculous or incomprehensible. The solar system is an atom lost in stellar space, and every atom, again, is a miniature solar system, a nuclear sun with planetary electrons.

II

Thus, modern thought is largely dominated[5] by the implicit conviction that this antithesis, of which some leading instances have just been cited, is central to all its problems —that the two standpoints here indicated are radically incompatible with each other, and that their stern conflict can be ended only by the victory of one great school at the cost of the total surrender of the other—of which makes no difference in principle. The keen intellectual atmosphere thus generated is undoubtedly healthy; nevertheless, the belief that only one of the two opposed systems can be finally true leads to so radical a perversion of the entire field of investigation as to nullify whatever secondary advantages may accrue. The possibility therefore that these two types of thought are *not* really antithetical, but are rather complementary—that each is concerned only with a phase of universal evolution which is indispensable to the other—that necessity, in short, is the logical basis of freedom, and freedom the inevitable outcome of mechanism—may be of sufficient interest to justify a brief discussion.

For obviously the general acceptance of such a solution would transform the whole speculative arena. The contestants would discover themselves to be allies, and their specific conclusions, instead of negating, would support and interpret each other. But its validity must be subject to one rigid condition—all the terms must be employed in their full and true meaning, with no attempt to evade the issue from the very outset by mitigating, through the use

[5] There has always been in philosophy some recognition that, *e. g.*, "there is no opposition between the inductive and the teleological methods." (Boyce Gibson, *Philosophical Introduction to Ethics*, p. 36.) I think it is true to say that any such "opposition" is in the main emphasized by science and still more by popular thought.

of metaphor or any analogous device, the extreme character of their mutual opposition as this presents itself *prima facie* to our observation.

The resort to such equivocal method detracts very seriously from the value of Bergson's consideration of this problem. His whole attitude markedly illustrates the initial assumption of a thorough-going antithesis between the determinism of matter and the freedom which reigns in the higher levels of existence. The following passages clearly express his characteristic position: "Matter is inertia, geometry, necessity. But . . . in a world where everything else is determined, a zone of indetermination surrounds (the living being). . . . Consciousness and matter appear as *radically different* forms of existence, even as *antagonistic* forms. Matter is necessity, consciousness is freedom." Thus the "radical difference" reaches "antagonism," and the widespread influence of Bergson's thought is a measure of the sympathy universally accorded to this mode of presenting the issue. But when we proceed to his method of overcoming this "antagonism" we find his "indetermination"—this vaguely negative suspension of material mechanism—elucidated by what is (I think obviously) nothing more than a metaphor. "Life is freedom *inserting* itself within necessity"; the "determination of matter" must "admit relaxation—a certain elasticity," and thus consciousness will "install itself. It will have to *humble itself* at first. . . . The slightest quantity of indetermination, by continually adding to itself, will make up as much freedom as you like." [6]

The self-contradiction here is patent. We begin with the absolute determination of matter, with "a world where *everything* is determined." Then, without any ostensible ground or attempt at rational explication, we have the purely dogmatic assertion of the "relaxation" of this deter-

[6] *Mind-Energy*, pp. 13-14. *Creative Evolution*, pp. 102-104, 139, 263. Italics mine.

mination, described—again most obscurely—as "a certain elasticity," and this comprehensive assumption is rounded off by the metaphor of consciousness "humbling and installing itself." All this is a mere evasion of the really crucial problem. For the antagonism between matter as necessity, and consciousness as freedom, is here only removed by an illogical endowment of matter with something which, whatever its precise nature may be, is *not* necessity—with something which is, indeed, the attribute essentially characteristic of consciousness (or life) itself, and when, by this feat of philosophic legerdemain, the primal determinism has been abolished, there is posited an equally gratuitous addition of "indetermination" which finally amounts to freedom.[7]

The inevitable result is a hiatus, a complete loss of the continuity requisite for real evolution: "with man a sudden bound is made. . . . The human brain resembles the animal brain, but it has, over and above, a special factor";[8] and this abrupt advance, finally, is based upon the possession by the human brain—which must be regarded, for the purposes of this argument, as essentially material—of a "special factor" (distinguishing it absolutely from all animal brains), the presence of which, as in any way material, would not be admitted by any modern physiologist.

Nor would physicists accept the parallel contention that there may occur such derangements of the conservation of energy—infinitesimal though these may be—as would permit of undetermined changes within some sphere of "indetermination" or freedom. "The invariable contrivance of consciousness" asserts Bergson (on the contrary), "is to elude the law of conservation of energy."[9] The minuteness

[7] The extreme character of the implications of this view are noteworthy. Dr. Bosanquet describes Bergson's philosophy as "the nearest approach to a serious belief in a wholly indeterminate career of the universe." (*Meeting of Extremes in Contemporary Philosophy*, p. 194.)

[8] *Mind Energy*, p. 20.

[9] *Ibid.*, p. 35.

of these purely hypothetical non-mechanical processes is indeed an indication of the logical weakness of this position; it evidences the implicit acceptance of the principle that the question concerns not the degree or extent of these changes but their essential nature.

Thus Bergson's postulation of a merely negative "indetermination" as constituting through its self-expansion true freedom, seems to lack a rational basis, and equally devoid of philosophical value is the belief, advocated by some classic ethical systems, that although the *reality* of freedom is indubitable, its *nature* is inexplicable. For Kant, as is well known, the guarantee of spiritual liberty is to be found in the practical, not in the purely theoretic, reason. Similarly for Fichte: "through no law of nature, or any consequence of nature's laws, but through absolute freedom, not by a transition but by a leap, do we raise ourselves to rationality." [10] Even so competent a modern psychologist as James echoes this belief. "James and his school deny that there are any laws of nature within the sphere of the will," [11] "the question of free-will is insoluble on strictly psychologic grounds." [12] In another direction, although religion and mysticism are amply justified in their advocacy of the reality of freedom, still their attitude to the content of such experience is easily seen to be radically different from that of philosophy proper, and while the volume of their witness can never be disregarded, still it must be taken as evidence and not as a final judgment upon the matter.

III

If then these three methods of removing the antinomy—that of Bergsonian "indetermination," of its analogue the

[10] *Werke*, vol. I, p. 298.
[11] Dean Inge, *Faith and Its Psychology*, p. 151.
[12] James, *Principles of Psychology*, vol. II, p. 572.

interruption of energy conservation, and of religio-mystical revelation—are excluded as being all alike philosophically defective, the only remaining starting point for the consideration of the whole problem is the unqualified acceptance of the absolutely determined, or completely mechanical, character of all the processes which occur in the material universe, as interpreted by the physical sciences of our day, and although it is by no means an easy matter, this starting point should itself be purely scientific, as distinguished from philosophical. This does not imply, however, that there is any rigid contrast between science and philosophy; they are, on the contrary, essentially continuous and reactive; but they must be nonetheless definitely discriminated in exactly the same way as are *e. g.*, the legal and the moral categories. The restriction, further, does not relieve us from all necessity of facing the philosophical problems of the nature of the "material universe," of space and time and of their relation to consciousness or mind or experience; it merely demands the postponement of these questions, on the ground that any prior philosophic conclusion, whatever its detailed character may be, must involve begging the question of the relation between freedom and determination. It will be sufficient for our immediate purpose to regard the "material universe" as the sphere of physical and chemical changes, including an aether of some kind as a possible if not indispensable medium for the transmission of energy, but excluding—because it is their character which constitutes the problem now under consideration—the phenomena of life, consciousness and personality. All these terms must be employed without philosophic implications or reservations, and with the meaning current in actual scientific discussion, and this enables us to restate the issue more definitely as turning upon the influence and range of purely physical laws in what may, for the sake of distinction and

contrast, be called the hyper-physical spheres of vital, psychological, and even sociological processes.

From this general standpoint, then, the "absolutely determined" character of all material processes is sufficiently expressed or defined by the principle of universal causation—of causal law, or the invariability of causes and effects, and here, once more, there must be excluded many difficult philosophic problems whose consideration, however necessary it may be for any really adequate discussion, is impossible within the limits of available space. But again the questions of the *final* adequacy of causal explanation, of its inexhaustible infinity, its relation to time, its validity within the real world or its restriction to the realm of thought, and of its affinities with other types of logical explanation,[13] may without confusion be discriminated here from the simpler conception of physical causation as implying the real and invariable sequence of certain definite phases of change or process; the characteristics of definiteness and invariability being the two postulates—in the pragmatic though not in the strictly logical sense—of modern physical science and of its formulation by means of mathematical concepts. In this respect, the rapidly increasing applicability of mathematics in its bearing upon the science of the physical universe throughout its entire range from astronomical to electronic phenomena—as instanced, *e. g.*, in the recent striking developments of the theory of relativity—is highly instructive. For—waiving once again the question of the relation between thought and existence—mathematical concepts must be perfectly definite (though this does not mean narrowly restricted), and must also express unvarying connections between the elements; though at the same time the range and flexibility of these connections are of the widest conceivable character, if not indeed universal. If then, as all physicists pragmatically

[13] "The use of the causal relation in a law is a confession of incomplete knowledge." Campbell, *Physics, The Elements*, p. 67.

assume, these concepts and formulae somehow represent existential reality, it follows that the real world must contain some entities at least which possess an identical definiteness of nature and invariability of relation. I may cite, in support of this general position, two recent utterances of unquestionable authority. "Guided by empirical data" asserts Einstein—and this gives us the essential foundation in existence—"the investigator develops a system of thought which, in general, is built up logically from a small number of fundamental assumptions." [14] Similarly, "integration leads to physically significant results only because it corresponds step by step to some physical process." [15]

Whatever then may be our ultimate philosophy of existence and experience, the principle of physical causation must be regarded as one necessary basis of scientific theory, and from what has just been said about its mathematical aspect, taken together with its absolutely determinative character, it logically follows that the causal relation must be thoroughly reciprocal—that the same cause (if these words are interpreted literally) must always have the same effect, and any given effect, once its nature has been exhaustively defined, have the same cause. If this reciprocity appears to be absent a keener anlysis of the given complex of phenomena will reveal that some of the relevant conditions have not been ascertained, or have not been assigned their proper value within the total relational schema.[16] *Analysis*, therefore, is of *fundamental importance*, and we must now consider the real import of the analytical method in itself.

[14] *The Theory of Relativity*, p. 123.

[15] Campbell, *Physics; The Elements*, p. 422. *Cf.* p. 414 on the "great physical significance" of dimensions.

[16] I may refer to Dr. Bosanquet's discussion of the logic of causation, in his *Logic*, Vol. I, p. 250; II, pp. 121, 174, 215; with the further references given there.

IV

For the widespread repugnance instinctively felt towards absolute determinism, which I have maintained to be an indispensable postulate of scientific—and even, at least at its outset, of philosophical—theory, arises in great measure from overlooking two essential features of the situation; first, that the definite linkage of the "same cause" to the "same effect" only becomes possible through prolonged, intricate and difficult analysis, itself based upon repeated and varied experiment, on trial and error, and on the incessant correction of inadequate theories, and secondly, that analysis always necessarily implies a prior synthesized real complex of some kind or other; analysis, *i. e.*, is impossible unless there is something to be analyzed. And when, still further, we recall the existential foundation of scientific investigation, we perceive that all the phenomena with which it deals constitute some portion or aspect of real existence, and that this reality—reflecting the profound difficulty of ascertaining its properties—must be, in its proper nature, of an inconceivably high order of complexity and interconnection.

This truth explains why all science—considered from the philosophic standpoint—is abstract; for the analysis of real existence which furnishes the scientific groundwork necessarily implies abstraction from the *totality* of facts and processes—implies the selection of those which are sufficiently closely allied to be included within any one category and the ignoring—even if but provisionally—of all others. It is of course true that as enquiry proceeds all the scientific categories, in their uninterrupted self-expansion, approach one another more and more closely; still no single science

is in itself adequate to the universe, and each retains therefore some measure of limitation. But of this abstraction there are many degrees. The more concrete sciences deal with entireties—with societies, individuals, organisms and compounds, and they are all characterized by the extreme difficulty of disentangling the exact and permanent relations which exist between their components. And yet, despite the obscurity of their interconnections, one principal aim of these sciences—and even to some extent also of history and moral theory—is to unravel the precise and unchanging laws which govern the entire field and confer upon it that systematic character which alone enables a truly scientific account to be given of its constitution.[17]

It is, I think, undeniable that all investigation of this kind tends towards, and is identical in principle with, the establishment of strictly causal sequence, and any hesitation to admit the truth of this arises merely from the inevitably vaguely defined nature of the "causes" and "effects" under consideration. Thus the historian enumerates the "causes" of the Reformation or the French Revolution; the economist describes the "effects" of currency inflation and the ethicist the influence—*i. e.*, the complicated resultant effect—of environment upon character, and all this despite the serious doubts so often expressed as to the justification and outcome of this introduction of strictly causal determination into the realm of immaterial process and spiritual values, allied with the fact that in none of these instances can all the "causes" and "effects" be traced and described. It thus becomes obvious that success in establishing unquestionably causal sequence demands a much further extension of analysis in the cases of realities which

[17] I may quote a recent lecture by Professor Heilbron, of Liverpool University. "It seems possible that the chemistry of plant growth will prove explicable in simple terms, obeying the ordinary laws of chemical reactivity, and that the methods of Nature within the plant cell will be reproduced in the chemical laboratory." The rapid expansion of causal theory within psychology constitutes an equally striking example of this tendency.

are concrete—realities, *i. e.*, which exhibit a complex but definite nature which persists largely unchanged in its essential features in spite of changes external to itself, or —more truly—thus persists because of an intrinsic capacity so to respond to these environmental changes as to maintain unimpaired integrity. This necessary further analysis involves therefore a still higher degree of abstraction from concrete reality; the reals must be still further dissected by the scalpel of the intellect—must become, as it were, reduced to more skeletal outlines or linear dimensions, and just as perceived space is geometrized into lines and surfaces, so concrete reality is thus simplified into a tissue of physical or chemical processes each of which may be isolated, accurately traced throughout the long course of its successive transformations, and even subjected to mathematical manipulation instead of actual observation or experiment.

V

It has just been remarked that, in one sense, such a theoretical dissociation and lineal connection of the elements of reality constitute the ideal of all investigation.[18] But what is its result? Its successful accomplishment at once takes us into the sphere of *purely causal* sequence, of mechanical or physical *necessity*—in short of absolute and immutable determination of part by part and of element by element; the sphere where the intellect, operating by means of the methods and categories of physical science, has achieved its most splendid successes. And if we choose to restrict the term "intellect" solely to the mind's activities within this limited region, it must be admitted that Bergson is justified

[18] *Cf.* with respect to ethics: "I should insist that in so far as moral facts are attacked with the inductive weapon, a similar attitude should be observed towards them as by the astronomer in dealing with stars." Boyce Gibson, *Philosophical Introduction to Ethics*, pp. 32, 33.

in his view that the "intellect" misrepresents or distorts reality, in so far as it regards the isolated and elemental processes which are revealed by analysis as being, in their isolation, ultimate and final reality. There is doubtless a strongly marked tendency to do this; for it is, naturally, extremely difficult to bring ourselves to regard results, painfully acquired through laborious investigation, as possessing relatively little substantial being and value; the analytical habit inevitably tends to become permanent, and the mind "subdued to what it works in." But the Bergsonian attitude towards "intellect" totally disregards that synthetic tendency and capacity of the mind, which not only dissects but also reconstitutes and which, indeed, when it pursues its deepest instincts, dissects precisely in order that it may revivify; nor is there any ground for sharply distinguishing between these two equally characteristic manifestations of the life of mind and applying to one of them, taken by itself, some special name such as "intuition." It is the one mind that operates throughout, now under one mode and now under the other.[19]

It is obvious therefore that exact knowledge, in the form of fixed causal connections, is obtainable only at the cost of extreme abstraction; all the phenomena which these describe form but a small proportion of the totality of being, and always subsist within a sphere far wider and much more complex than themselves. And this comparative simplicity logically involves two further features of fundamental importance—features which though distinguishable are really but two different aspects of the causal process; these are (*a*) sequence and (*b*) externality. It appears to be too often forgotten that mere sequence, as such, is really only an attenuated form of the true relation

[19] Dr. Bosanquet's recent severe criticism of "the superstition which sets up a bugbear called intellectualism" is, I think, worth special notice; he connects it with "what is most superficial and most characteristic in modern progressism and ethical culture." *Meeting of Extremes in Contemporary Philosophy*, p. 100.

between effects and their causes. For while all these are sequences, not all sequences are causal, even when indissolubly associated. Every transition from cause to effect, which is not merely hypothetical but existential, is an element in the entire dynamic evolution of reality—it implies something underlying sequence which we call "action"—"agency"—"energy"—"influence," and unsatisfactory though these terms may be, still they represent something dynamically operative within the material world,—something radically different from that static relation of sequence which characterizes certain types of logical and theoretic connection. There is certainly in modern science a marked tendency to dispense with such dynamic concepts —to reduce science to merely descriptive formulae devoid of all implication of ultimate causal explanation—which is prominent in many expositions of the theory of relativity. But while this is quite justifiable as an extremely useful methodological principle of mathematics or of pure theory, to extend its application to the real world—to eliminate, *e. g.*, force or energy, aether or gravitation—is obviously carrying abstraction to unwarrantable lengths.[20] Every existential causal sequence therefore implies a real dynamic process—one further step, *i. e.*, in the development of the universe which Dr. A. N. Whitehead has happily denominated "the passage of nature."[21] This discloses a further defect in Bergson's conception of "intellect"; for he asserts that this is incapable of yielding anything beyond static or geometrical presentations of that reality which is in truth an unending dynamic process. It appears to be obvious, on

[20] This is of course fully recognized by many physicists. *Cf.*, "Einstein's theory, though it helps us to discover the laws according to which phenomena occur, cannot lay claim to provide a mechanical explanation of them." (*Nature*, 31 March, 1921, p. 134.) "Force is fundamental, as volume is fundamental." (Campbell; *Physics, The Elements*, p. 392.) "The propagation of light will always be sufficient ground for belief in some reality by means of which the transmission is effected. The aether must be rehabilitated." (Cunningham, *Principle of Relativity*, p. 29.)

[21] *The Concept of Nature*, p. 54.

the contrary, that the "intellectual" concept of causation itself implies that very apprehension of the dynamic nature of reality which Bergson seeks to confine to the faculty of "intuition."

VI

This leads us to the consideration of "externality." It is, in the first place, plainly impossible that there should be any "determination," in the literal sense, apart from the real existence of some agency, energy, or influence, however inexplicable its character may be, and admitting this existentiality, the root difficulty which is felt in accepting universal and absolute determination lies in what is perhaps best called its "externality." Whatever is determined, it is argued, must be determined by something other than, foreign, and external to itself; so far again as this is really, and not merely apparently, the case, it is obvious that freedom is impossible, and hence arises, as has been remarked already, that instinctive hostility to the introduction of deterministic concepts into the spheres, *e. g.*, of life, moral experience, or social development.

Now just as physical[22] causal theory, in its existential reference, involves both sequence and dynamic process, so it involves, logically, what I have called "externality." For whenever any complex group of events or processes is submitted to scientific analysis the result necessarily is that, just in being distinguished from each other, the determinative cause is placed *outside* the determined effect; notwithstanding that they still remain connected in and through the causal relation and so constitute one unity for thought. Effects and causes are thus inevitably external to each other, even though the cause survives in the effect, and the effect, conversely, contains the cause within itself; for ade-

[22] In its widest meaning, to include all processes below the level of life.

quate knowledge enables the nature of either to be inferred from the other.

Bearing all these considerations in mind, it now becomes possible definitely to summarize the crucial issue between determination and freedom. The form of scientific enquiry in itself involves, both in practice and as an ideal, an analysis which reveals universal dynamic external determination. It appears to me impossible to deny the truth of this as a regulative principle of thought; the only basis for its criticism is pragmatic—*i. e.,* not really logical—and rests upon the limitations of its applicability—on the citation of cases with which, at the present moment, it fails successfully to deal. But all these difficulties arise from ignorance; they are rapidly disappearing as knowledge increases, and although it would be ridiculous to assert that all obstacles will some day vanish, it still remains true that no inherent limits can be assigned to the discovery of specific determinative connections wider and deeper than any hitherto ascertained. Frontal onslaughts upon determinism, therefore, are foredoomed to failure; nor will flank attacks, under the banners of noümenal experience, transcendental realities, or intuitional capacity, fare any better.

In face of this conclusion, how it is at all possible to effect any true reconciliation between determinism and freedom? It can be attained only by the adoption of altogether different tactics—by a method analogous to that wherewith Kant rebutted the skepticism of Hume; that is, by delving still more deeply into the nature of reality; although in so doing both subjectivism and intuitionism must be totally dispensed with. This method consists, then, in the systematic reversal of the course of our thought; in other words, in first of all carrying analysis and abstraction to their uttermost limits as expressed in the fundamental principles of physical science, and then *retracing our path* carrying the results thus obtained with us, reinstating

them within the whole of real existence, and thus rising from the plane of sheer abstractness to the higher levels of concreteness.

This procedure in no way deprives the mechanical sciences of their value by imputing to them any *absolutely* abstract character, much less a status merely fictional, conceptual, or formularistic. On the contrary, it conserves their value in two ways; first by maintaining that—in principle, and subject only to secondary qualifications—they express certain aspects of the actual nature of the material universe,[23] and secondly, by accepting their conclusions unimpaired and uncriticized—once more, of course, in principle, and in accord with further advances in knowledge—and so incorporating them within a more comprehensive body of truth.

VII

What then—and this is the last stage in the consideration of the subject—is the result of thus retracing the path which our investigation of reality has followed? The reply is obvious; analysis forthwith ceases, and its place is taken by its complement—*i. e.*, by synthesis, or, more truly, by a *re*synthesis; for (as has been already emphasized) it is upon some synthetic complex that all enquiry, scientific, historical, or other, is from the very beginning directed. But our new reconstruction is no mere repetition of the old; it is the old reorganized, re-created, ordered instead of chaotic, impressed with law in place of contingency; or if we choose to regard the matter from the broad standpoint of evolution, then, as Professor Kemp Smith insists, "Knowledge starts . . . from the complex situation in

[23] "All causation has an element of revelation"; Dr. Bosanquet, *The Meeting of Extremes*, p. 81.

which the race finds itself at the dawn of self-consciousness." [24]

The analytic method, then, finally sundered Reality into parts which, taken in their distinction, are isolated except for the causal sequence which holds them in the bonds of determinative necessity; each, thus distinguished, follows its predecessor in an unending series which tends (as physics develops) to become more and more linear. The later synthesis, therefore, removes this abstract tenuity; it replaces all the elements within the wholes from which they were originally derived, but—and this qualification is of supreme importance—it reinstates them indelibly impressed with that determinist relation and interconnection which is discerned by analytical science. Thought thus advances from the electron, by way of atom and molecule, to the most complex compounds known to organic or to bio-chemistry, and thence to life, consciousness and society; or from the planet, fatalistically urged onwards through the space-time continuum, to the self-contained and (though perhaps only in a measure) self-regulated solar system, if not indeed still further to absolute space-time itself. For it must be remembered that the age-long evolution of our system, apparently uninfluenced from without, is a continuous and complex development which, while in one sense undoubtedly "mechanical," presents in another aspect a remarkable parallel to the growth of a living organism.[25]

In this manner, thought comes to deal with organized totalities—complexes—wholes—which, being constructed from elements all causally related, are characterized throughout by the determinative process. And with this, our argument reaches its conclusion; for determination, thus retained and incorporated within the including totality, completely *changes its own nature.* It has now lost all

[24] *Commentary to Kant's Critique,* p. xxxviii.

its "externality"—which, it will be recalled, is the ground of its repudiation and exclusion from the world of spirit—and has acquired "internality." It is now included within some containing whole, and this radical transformation constitutes the crucial transition from "necessity" to "freedom." For instead of a mere lineal sequence of elemental parts, each of which is determined wholly from outside itself by its predecessor, we now confront a complex *totality* which includes some degree—larger or smaller as the case may be—of the determinative process and relation within its own being, and is therefore, to that degree, internally or self-determined.[26] This internal determination, further, must obviously advance *pari passu* with the increasing complication and comprehensiveness of the synthesized complex. More and more this comes to form a unified system of differentiated components, each of which dynamically contributes, according to its specific nature, its distinctive quota to the character of the containing whole; for in every true whole differentiation does not impair, but rather constitutes, its unity. To ignore this principle is to confuse unity with uniformity; unity demands differences between constituents, and the greater these differences the profounder is the unity.

Now freedom is only truly comprehended as this internal or self-determination. It is never the suspension or the absence of determination, whether frankly called such or disguised as "indetermination"; that is nothing other than sheer disorganization or chaotic anarchy. This truth has been abundantly illustrated by the universal demand for political or economic "freedom" which has followed the war; for by such freedom is always meant some degree of

[25] The titles of two recent volumes are very suggestive. *The Life of the Universe* (Arrhenius) and *The Birth of Worlds and Systems* (Bickerton).

[26] "Self-regulating mechanisms are the hall-mark of life"; (Dr. Huxley, *Science Progress,* October, 1921, p. 241). Dr. Whitehead extends this conception to the ultimate physical elements. "The stream of events which form the continuous series of situations of the electron is entirely self-determined." (*The Concept of Nature,* p. 159.)

national *self*-determination—the term, fortunately for philosophy, has thus become widely popularized in its true meaning of internal regulation, instead of external or alien dominance. In an ideal state, again, every citizen (himself also ideal) would play his proper part in its self-direction, and so the ideal state, or the ideal person, becomes the familiar type of every ideal whole, as being a system infinitely diversified within itself, but nonetheless perfectly and definitely interconnected and interrelated, with each part fulfilling its true specific function and so advancing without hindrance or loss the progressive evolution of the whole.

VIII

Every such unified whole must therefore possess, when viewed in its integrity, some degree of real freedom; but on the other hand, an adequate analysis would always resolve its inner constitution into thin and disconnected strands, as it were, each of which taken alone would exhibit fixed causal connections. Everything therefore depends upon the chosen point of view—upon our selection of *analytic* abstraction or *synthetic* concreteness—combined, of course, with the requisite power of insight and the final purpose of the investigation. It is, indeed, only the limited range of our power of observation and interpretation that prevents our perceiving the predominance of self-determination even within the material universe. The infinity of its spatio-temporal extension necessarily involves that only relatively minute fractions of its total process fall within any given immediate experience, and in consonance with the trend of my whole argument, these isolated elements can then present nothing except externally determined relations. But once we grasp the concept of such a mate-

rial whole as *e. g.*, the solar or a stellar system,[27] its "mechanical" character is at once seen to be a mere abstract aspect of its deeper attribute of eternal self-regulation.

A relative simplicity of organization, then, characterizes all the objects of the material universe. But evolution brings into being, in the realm of life, entities which combine a high complexity within very small compass; hence, it is extremely difficult to trace out their causal interrelations, and this, combined with our instinctive aversion from purely mechanical determination, creates that illusion of the false type of freedom which is supposed to consist either in the total absence of "mechanism" or in its subordination to some "higher" but indefinable category, typified by Bergson's "indetermination," Driesch's entelechies, or the older concept of "vital force."

And with the appearance of consciousness and personality, all these contrasts and apparent contradictions are enormously intensified; but it would be tedious, I think, to carry the application of my argument any further. It will be sufficient to add that nowhere do we find either (on the one hand) an *absolute mechanical* determinism, nor (on the other) an *absolute* degree of freedom, thus conceived as self-determination. In the most rigid mechanism there is some degree of self-determination, and the freest unity reposes on some basis of external determinism, and between these two extremes the universe presents an unbroken series of gradations which connect them together. But absolute freedom pertains only to the infinite whole of Being—infinite not merely in time and space but in complexity and perfection. Hence, arises that essential paradox of man's spiritual nature with which this enquiry began. In part, we are truly free; in part, we are deter-

[27] Such as a multiple star group. Other instances are meteorological changes, or oceanic currents, taken as uninterrupted and ubiquitous. (I find that these cases have also been cited by Professor D'Arcy Thompson; quoted by Professor Hoernlé in his recent *Studies in Contemporary Metaphysics*, p. 168.)

mined from outside ourselves, and this is plainly inevitable, since each of us is but a fragment of the all-inclusive whole.

> There's a divinity that shapes our ends
> Rough-hew them how we will.

To "rough-hew," then, we are free—truly and absolutely. But the finer shaping—the exquisite dovetailing of each and all into the perfect End—that is not for us. "There's a divinity."

J. E. TURNER.

LIVERPOOL, ENGLAND.

CAUSE, PURPOSE, CREATIVITY

The gossamer spins a silken thread
To go a-drifting, drifting!

I

FROM the top of a certain mountain in the Front Range of the Rockies, one may see the horizon more than seventy-five miles away to the east, lying flat upon the blue-gray plain. Laid out upon the floor of the plain is a wonderful pattern of colors and values. The shining white sands of the distant arroyos are waves that beat against the shores of a shimmering lake. The cloud-shadows float across the mesas and disappear, even as did the tribes of long ago which have followed the Ghost-trail to its end. The long stretches of sage fling a gray veil over the buried history of centuries. Winding roads that mark the paths of buffaloes now lead nowhere across the vacant plains. A little puff of white smoke on the horizon's rim is the mark of the civilization which has drawn transportation lines and acequias through the colored pattern. The blooms of a few steel windmill towers are to be seen here and there. And behind to the west the Sangre de Cristo range lies in majesty, scornful of the puny race that have reached its feet.

The philosopher has followed an attractive canyon, down which flowed the clear fresh air of the mountain's crest. Its tang hastened his pulse, increased his pace, lighted his eye with a profound sparkle. Its rustling whispered of the height beyond, the rare blue sky and the far-

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spread horizon. The brook dances down showing lacy whiteness where it drops from boulder to boulder, and molten green where it glides swiftly along singing of the spotless fields of snow upon the summit. Harebells sway on slender stems, ringing a little chime to call the worshipper to the austere temples high above. Mariposa lilies hold up their delicately tinted chalices in adoration of the Trinity of Light, Air, and Freedom. Columbines swing sapphire lights, like fairy guides to the mountain meadows. The harsh and jagged granite walls have traitorous ledges but even on their precarious sides cling the bearberries covered with white stars. A crystalline cascade pours through a narrow notch, but beyond there is nothing to bar the way except the broken trunks of evergreens. The yellow sun pours down the slopes, the long purple shadows robe the mountain in mystery. All around is snow, solitude, silence. Above glows an indigo sky.

The philosopher sees the towering peaks on one side, the patterned plain on the other, and whispers: Cause and Effect. He sees the advancing puffs of white steam—the locomotive's breath—he sees the checkerboard city far below, the windmill flowers, the ranch-houses, and he whispers: Purpose and Result. Then the two concepts begin to fly like two butterflies in intricate interwoven paths, till purpose becomes cause, and cause becomes purpose. He sometimes fancies there is but one butterfly, but, lo, soon there are two! Is the grey veil of the sage only an effect due to an impersonal cause or is it laid with careful grace by a personal purpose? Is the hurrying life of the summer city below animated by the conscious purposes of many individuals, or is it but the play of human atoms under the impulsion of cosmic forces? Is the chime of the harebell a vibration in the harp of the nervous system, or is it a song in the dreamer's soul? Is the singing brook a dancing maiden or is it but the downward flow of energy?

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Irresoluble duality of Light and Darkness, Night and Day, Good and Evil, Cause and Purpose! Is there no Unity? What is the synthetic, monistic answer to the riddle? The wide horizons and the unfathomable blue sky hint that though Man think and investigate, through all the fleeting centuries never will he come to the end of his trail. But the song of the brook and the whispering breeze suggest a different answer to his questioning spirit and he feels that if he but listen aright he will hear the riddle read. The mountain spirits gather as they did for the early tribes in these regions, and as he feels their unseen presence, he can see the writing on the rocks, and understand the flight of the bird,—he finds that the universe is indeed a unity.

Man has always felt himself to be a stranger in the world around him. From the earliest dawn when he heard the wandering spirits of the morn stealing away before the rising sun, when at night the brilliant stars told tales of the depths of the sky, and in the day the waves of the sea crooned melodies of the caves it hid far below, to the present, he has been enchanted with the mystery of the world of nature. No spirits seem left to whisper now, nor singing sea to weave a spell around his mind with its song, for the brilliant stars are studied in photographs, and the dredge brings up mud from the ocean floor. Man has always known that he had purposes, and he has matched his purposes against the causes of nature, his ingenuity against the raging torrent, his indomitable courage against apparent defeat. He explores the air above and the sea below, the polar ice and the tropic jungle, the tornadoes on the sun, the huge mass of Betelgeuse, the distant universes that wind their spirals in century-long curves, and the transient grace in the fluttering ribbons of the Aurora. He has given himself new senses with many instruments with which he can see the chemicals on Sirius, the shadows of the lattice of the crystal, the long wave of the electromag-

netic field. He weighs the imponderable, sees the invisible, hears the silent. And he tries to bridge the gulf between his purposes and the causes of the physical world by allying himself on the one hand to the animated nature he knows, and on the other side to pass smoothly over from the physico-chemical to the living creature. Upward, Cause thrusts its greedy fingers to grasp the living in its invincible hold; downward, Purpose creeps through every crevice to open the channels of freedom. Sometimes, indeed, Cause looks like Purpose read from the past into the future, and Purpose resembles Cause read from the future into the past. And yet the two butterflies are always two in the end. It is not all purpose, nor is it all cause. But it is all CREATION.

II

Causes are multitudinous and gregarious. We say "the man was killed because of a rifle shot." But he was killed also because of the powder, and the trigger, and the rifling of the barrel, and the weight of the bullet, and the angle of fire; because of the wound in the heart, and the destruction of the nervous system, and the derangement of hundreds of bodily coördinates; because of the hate of the man who fired, of the days of brooding over a distant injury; because of all the incidents that produced the situation which culminated in the injury, the insult; because of the childhood and education of himself and his adversary; because of the long sequence of human life upon the earth including all the causes of their ancestry; because of the rotation of the planets and the pull of Sirius and Polaris—because of the whole Universe. For Cause is a vast and intricate network—if it be at all—so closely interwoven that the minutest deflection at any point, the slightest derangement of any filament, however small, would change the sequence

completely and might lead to entirely different results. "Had it not rained the night before, Napoleon would not have lost the battle of Waterloo." If cause holds its imperious way unchallenged, the flicker of an eyelash causes the quivering of the most distant sun! What though motions be small! Cause is not cause unless it is *mathematically exact,* and that makes the meanest particle of as much importance as the hugest star. There is no slack in the Cause Machine; no loose play of joints, bearings, gears; no elasticity of bars; no flexibility of parts; precision of the most definitive sort sways every new configuration. The paths of Cause never fork, never come together. If they forked the choice of path would be beyond Cause, if they touched it would be the same as a fork. Even though worlds collide, each particle follows its own ordained path, with its own differential equation that has but a unique solution. There is no indeterminate equilibrium, for the dice are always loaded and the future resolution of the instability was predictable. Cause determined the path of every tear that rolled down the cheeks of the millions who followed Bernhardt to her tomb. Cause said when every sigh would be uttered. Cause swept every wave of feeling and sentiment over the heart of all Paris. Cause brings to pass the illusion that we are free. There is no selfishness in the world of Cause, for is the earth selfish in choosing its one path through space, or the electron in vibrating in its tangled orbit? There is no hate in the world of cause. Does the meteor hate the air that burns it up? There are no ideals in the world of Cause. Did the teeming life of the Carboniferous period dream of man and the angels? Cause even brings it about that man hates Cause! Cause fills the heart of the Poet with dreams of Freedom, with Ideals of Society, with undying Love, with visions of worlds where Cause is transcended! What bitter irony! Yet Cause is neither beneficent nor maleficent. Inscrutable,

impersonal, devoid of emotion, forever and a day every creature in the universe follows its path, like a leaf driven by the Winds of Destiny!

Yet, what is Cause? It is a conception in the mind of man, or rather in the minds of some men, which they undertake to fit to the universe and all its contents. What is the evidence of the fit? A patchwork in which the pieces are separated with crevices that however one pulls and attempts to make the fit perfect, what disappears in one place reappears in another. All measurements are flagrantly approximate, but Cause needs absolute precision. All laws are only true within certain limits more or less definitely given, yet Cause demands no margin. All experiment is partial, abstracted, interpreted, yet Cause permits no partial view. All experience is limited to parts of one rolling sphere, yet Cause needs a complete knowledge of the entire Universe, whether small as an electron or huge as Betelgeuse. No hypothesis can ever be proved by verifying it. It can only be proved by showing that all opposed hypotheses are untenable. Yet Cause demands that every hypothesis be the correct one. And the ocean of knowledge is strewn with the wrecks of hypotheses which in their day set sail for the ports of Truth gaily. Is it Cause that set them going and sent them to destruction? Cause is a conception. It is not to be found in the air holding in its fingers the molecules, and placing them where they should go. The sea saith it is not in me, and the mountain echoes not in me. Cause cannot be matter, nor electricity, nor ether, nor force, nor energy, nor momentum—the attempt to even think of Cause thus shows its absurdity. Is Cause then non-material? How does it hold in its iron grip so much matter if it is non-material? We must not shirk the issue. Merely to say that Cause means certain uniformities we have so far observed, is not Cause. That the sun has risen several million times does not say that it must rise

tomorrow. A formula can be written which will give for its values every prime up to ten million, and yet fail on the next prime. Cause means complete Necessity, utter Determinism, else it is not Cause, and that which has no cause slips in. Cause has but one explanation. It is everywhere unique.

Cause being under the dominion of causes would have to be the unique product of those causes. Yet we find another conception that runs quite counter to Cause, and is of equal importance in the world and life, which would also have to be the unique result of the same causes as Cause, namely, Purpose. Either or both must be the result of all the antecedents in human history. How such contradictory effects can emanate from the same unique sources by a route that never has more than one path is a mystery to give us pause. The only tenable answer is that both are conceptions and neither is the result of inexorable laws of a dominant Cause. In other words, Causation is merely one of the *modes of viewing* the universe, of at least two. And we are free to examine the universe from either angle. Viewed in one way we see certain things. Viewed in the other way we see different things. Either view is partial.

III

Purposes are individual and solitary. Purpose looks to the future and by it determines the present. Cause looks to the past and from it determines the present. Cause says what has been decides what is. Purpose says what is to come decides what is. Purpose is thus Cause working backward. To say that the Universe is what it is because of certain purposes is to put in a new sort of determinism, and though not as rigid as that of Cause, none the less inexorable. He who can design and wreak his will with certainty is a cause, though he be able to form a different

purpose every day. A future controlled by Purpose is a future controlled just the same. It is no longer the totality of the Universe producing results, it is the collection of individuals with purposes producing results. There is no longer one route merely: there are as many routes as individuals, or at least as persons. The paths are now an enormous tangle. Under Cause, each was separate and laid smoothly out to be traversed with no interference from the others. Now they are inextricably webbed together and much in conflict. From an absolute autocracy we have passed over to absolute anarchy. We have the survival of the stronger purpose.

Time was when Man viewed the universe under the dominance of the conception of Purpose almost entirely. The weird comet was for the purpose of warning him of approaching war. The rain fell for the purpose of promoting his crops. The lightning blasted his hopes for the purpose of teaching him humility. The waving grass grew for the purpose of being eaten by his herds. His herds waxed fat for the purpose of furnishing him food. He himself was for the purpose of glorifying God. The vast coal layers were stored for a purpose, as well as the lakes of oil—no doubt for driving automobiles in the twentieth century. The earth itself was tipped on its axis for the purpose of diversifying the seasons and so educating more highly the subduer of its surface and interior. The sun sank in the green-gold west beyond the molten islands floating in an amber sea, to paint a picture which would suggest the heavenly shores. Tragedy laid its cold hand on his heart to make him repent of his sins.

It is true Nature and civilization are full of purpose. The cactus-thrush builds its nest amidst a multitude of thorns for the purpose of protecting its young from snakes and other animals. The rattler sings his sinister warning for the purpose of driving away animals too big to swal-

low. The quail flutters apparently helplessly about for the purpose of diverting attention from the hiding-place of her tiny brood. Most of the life of animate nature can be interpreted as purposive. So, too, Man has marked the earth with monuments of his purposes. Many of these remain to be re-read after the dust of the centuries has been taken from them, but no one doubts they are the result of Purpose. Purpose spread the civilization of Rome together with the sway of the imperial eagles. Purpose drove Columbus and his little squadron across the Sargasso sea. Purpose has made the Indian fade away from his land even as the buffalo. Purpose has bound the new continent in ribbons of steel. Civilization is Purpose wrought out in new designs.

But we must not forget that Purpose is no better than Cause in the full explanation of things. One is a view of the receding landscape we have passed, showing our track and the relations between things as they were, the other is a view of the landscape sweeping down upon us, with the possibilities ahead. To make use of these possibilities demands just as definite a path as it did to arrive at our present station. If we fashion events by means of a fixed ideal or notion we have formed in some way or other, that in itself is just as much a cause as any other cause. And if causes bring about a better adaptation to environment that is just as much purpose as any other objective in view. We become so absorbed in looking at one side of the coin we forget the other side. We forget we have stamped both sides together. The harebells sway on their delicate stems both for the purpose of propagating their seed and because they are the product of all their antecedent causes. The laughing brook dances down the canyon's slope fully as much for the purpose of reaching the ocean as because the potential energy tends to become kinetic. Purpose is undoubtedly present in the animated creatures on the

mountain-side, but it is also present in the inanimate creatures as well. And we do not evade the difficulty by waiving all consideration of both cause and purpose and trying to be content with a mere account of the universe. Unfortunately, the restless mind within us is always seeking, seeking. It will not be drugged into an indifferent sleep. And we realize that we are not only the immediate analytic continuation of the directly preceding past, but we are also the varying definite integral of the entire past. We realize that we not only affect the immediate future but we project our vision into the distant future. But we also realize that neither is a complete account of what takes place in human life either viewed in small intervals or as a totality. There are always new terms entering the equation at every point of the process, which are neither the continuation of the past nor the prevision of the future. There is the play of a spontaneity which has no cause and no purpose. Indeed, it originates causes and purposes both. The game is not merely the result of certain fixed rules, played with certain possible though different designs. New rules are introduced every now and then, and they reflect the path of the game in ways unaccountable on the bases of cause or purpose. In fact, we come to see that both Cause and Purpose are the outcome of a spontaneous Creativity. The old conception of invincible Cause, which had its roots in the futility of much human endeavor, as well as the old conception of Purpose, which grew in the successful culmination of human projects, must give way to a flower whose blossoms are of unexpected beauty, whose foliage is never the same, which does not grow according to nursery descriptions, nor fruit according to horticultural plans. Creativity is not the outcome of Cause nor of Purpose, nor the fruit of their union.

IV

Creativity means to some merely putting old things together in new combinations. Something, we may say, like a child building a new tower out of his old blocks. We may take a few instances from the field of Mathematics. The notion of Klein that a geometry consists only of the theorems about the invariants of certain groups of transformations of space is a new notion, and in a sense he created an endless number of new geometries in this way. But the idea of invariant, of group, of transformation of space, already existed and were waiting to be viewed in this new light. They did not furnish anything which could be said to be entirely new in mathematical thought. New methods entered Geometry in consequence of this programme of Klein's but the materials of Mathematics were not increased any. When the irrational number was added to the list known to the classical world, however, a new entity, or class of entities, came into existence, which gave the mathematician new power. He could now solve new equations, and could resolve old equations which he could not touch before. The irrational number was not a new view of rational numbers, or their combinations, nor was it a new view of equations, and their relations to their roots. Before the irrational was created the equation $x^2 = 2$ had no root. Since quaternions have existed, it has an infinity of roots. The irrational was not an abstraction from natural phenomena either, for it does not occur in measurement. It was not sifted out by a finer mesh from the contents of experience. It was a spontaneous creation of the mind of some genius of that period. The so-called imaginary $\sqrt{-1}$ was equally a spontaneous creation. So little contact did it have with the "real" world that for centuries

it was regarded as purely fictitious. Only recently has it been found to be applicable to the physical world. It did not emanate either from the notion of irrational, for it is in no sense the limit of rationals in the same way as an irrational number. It involved the new notion of "quality" in number. Mathematics is full of examples of the creation by new combinations, and the creation proper by the spontaneous appearance of new entities.

The creation of a new class of entities in Mathematics usually adds a new branch to its growth. Thus the creation of the irrational and its followers, the various ensembles, brought the branch Analysis into being. The creation of number with quality, negative numbers, imaginaries, quaternions, brought Algebra into existence. The creation of "operators" of various kinds brought the Theory of Operators. There is sufficient reason to warrant us in asserting that the whole of Mathematics is of this spontaneously created character. We cannot enter into the discussion here. But no one can traverse the realm of the multiple fields of modern Mathematics and not realize that it deals with a world of its own creation, in which there are strangely beautiful flowers, unlike anything to be found in the world of external entities, intricate structures with a life of their own, different from anything in the realm of natural science, even new and fascinating laws of logic, methods of drawing conclusions more powerful than those we depend upon, and ideal categories very widely different from those we cherish most. He will inevitably (if he reflects long over what he does) come to the conclusion that either such an ideal world exists and he is the discoverer who wanders through these unknown forests, caves, deserts, mountains, and fairy glades, or else he will conclude that he is himself the creator of this world either spontaneously or at the suggestion of some other mind which itself spontaneously created the new forms. For

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certain reasons the latter would seem to be the more certain conclusion. He becomes then more adept in finding this kind of world elsewhere than in the regions peculiar to Mathematics.

For instance, let us consider the region of physical science a little. A line of force can scarcely be thought of as an abstraction from the data of experimental work. It is an emanation from the mind of a genius. Yet it has become a very real and useful entity in the world of modern physics. It is true that attempts have been made to manufacture lines of force out of streaming electrons or by other material forms, but not with conspicuous success. And it matters little whether one could ever find a forceps so delicate that he could pick up a line of force with it and hold it in front of his microscope for examination. The world of physics consists of so many creations which are immaterial that a few more make little difference. We need to mention only entropy, which has actually been reduced to the logarithm of a probability, yet which to many physicists is as real an entity as energy. Electrokinetic momentum is another entity which can be measured by the cubic centimeter, which can produce momentum in real matter, yet which is itself of a quite immaterial nature. "Ponderomotive force," also measured by the cubic centimeter, is space-filling, but is a ghost of very powerful character, as every trolley-car knows. We could go on and enumerate other entities in physics which came out of the thin vacuum of thought, yet are considered as very material in character. Even in mechanics such a common thing as motion can scarcely be called material. The physicist is compelled to admit that all these entities are merely names for mathematical relations or else that they are ideal creations of his own, and that his world is largely made up of such creations.

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The chemist is no better off. He has created so many atoms that he is quite uncertain at present what atom he likes the best. From the little hard, impervious indivisible atom of former days, he passed to particles with fingers that reached out to grasp similar fingers from their partners in the cosmic dance. From these, he has passed to a complicated system that rivals the celestial mechanics in complexity and difficulty, and these systems are not only diverse but incompatible. In some there are electrons that whirl in dizzy spirals with incredible speed, others in which the electrons merely swing gently to and fro about their points of equilibrium, others in which the electrons are closely packed together and practically stationary. If these were abstractions from data they should have more similarity. But in fact, the electron itself is a creation. It is not a residue of experimentation but of the experimentor. No one ever saw an electron—at the best the radiation from an electron may have affected his retina. When we pass over to stereochemistry with its necklaces strung together in chains, pendants, clusters, wreaths, and other beautiful diagrams, we surely admit that they are pure creations of the chemist's mind. Does any chemist really think carbon makes the tetrahedral forms ascribed to it?

The biologist has added his share of creations, which too often he comes to think are material realities. He has created the "character" which he is hard pushed to locate in the lines of the living cell which he calls chromosomes. He has strained the limit of vision to the maximum and even though he thinks he has broken up these lines into definitely arranged particles, he must at last sink back knowing that vision can go no further, and that he has merely increased the intricate complexity of the problem, and is no nearer seeing a material "character" than he was. And when he endeavors to pack all the future possibilities and potentialities of the living organism into the minute particles that

make up the chromosomes, he is compelled to imagine or create a whole cosmos inside each particle, and this is not observation; it is creation. The most rigid mechanist is ultimately compelled to create for his cells, fibres, synopses, an uncanny power of action which is not observed, but is an inspiration of his own, breathed in, that the mechanism shall have life.

We need not pause with the psychologist. So many have been trying to deduce mind as an abstraction from material entities, and with such a constant interjection of creations, in order to make the scheme work, that it is no difficult matter to see that much must be done in this field to clear up the results of study. From physico-chemical equilibrium, through reflex arcs, to behaviorism, one may see the true psychology pushing its way. It is already flowering with spontaneity in some gardens.

When we leave the region of natural science and pass over to that of anthropology—in the wide sense, the study of man,—we find many creations. In fact, the fertility with which they spring up is a characteristic feature of man. We may readily grant that various forms of government are survivals and are in some sense abstractions. The democratic forms, for instance, might have come from the time when the evolving tribes or families were not dominated by any one person whose character or attainments made him the leader; and that autocratic forms came from the period when the strongest asserted his power and became the king. But when man heard the voice of the wind and the angry hiss of the lightning searching him out to strike him down, he was beginning to pass from abstraction to creation. When he created for himself a soul, even the modern psychologist will admit it was a creation. And when he created Immortality it was in no sense an abstraction from his experience. Since then he has created many things, such as honor, chivalry, justice, mercy, charity, and

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these are very real and moving entities in his daily existence. It may be difficult to decide, with the meager array of facts we have, whether all these can be called direct creations, but enough examples may be found.

When we pass to the domain of the fine arts we are in the very home of the creative ability. For every work of art is the attempt of the artist to express in concrete form a creation that is struggling within him to be released. It may be Pygmalion creating Galates, so beautiful that he prays the gods to breathe into her the vital spirit. To say that he chiseled away the marble till he had worked out the abstract residue, and found it beautiful, is too absurd for consideration. It may be Prospero creating Caliban and Ariel, Titania, and Oberon. It may be any painter endeavoring to make line and color express the vision he has in his mind. It may be any musician weaving harmonies and disharmonies together to express the rhythmic emotion which he feels in his heart.

To argue that all these had antecedents which must therefore have been their causes is to dogmatically assert what not only cannot be proved but which carries on its face its own repudiation. To assert that they were all due to a purpose in the mind of their creator is equally to be dogmatic, and the facts do not justify such conclusion. They are usually the result of the life of the creator it is true, but only in the sense that they come into being as part of his living. That they would not have been different could the life be started anew and brought up to the same instant, is a dogmatic assertion which has no chance of ever being proved or disproved. So far as we know life goes on and never goes back, hence we can make no experiments upon it. We can merely observe what comes. Whether it could have been different or not, is not a matter we can try out in the laboratory. All we can do is to examine the outcome analytically and decide from its

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nature what is implied. In the end this may be called a mathematical method, so far as it deals with implications, but it is more than that, for it has in it the direct perception of certain elements which are not implied. It is this clear insight into the nature of the universe and its contents which is the most certain method of arriving at permanent results. This insight is that of the mystic, of the artist, of the genius in science. What they have to report as the result of such insight is of far more value than all the deductions that can be drawn by however skillful an analyst.

For after all, the logician himself is obliged to explain how it is that an inference must follow from certain premises, and when pushed to the wall all he can reply is that we see mentally that it must be so. In other words the logic machine has been built to produce certain results under certain conditions, and it has to be supervised by the living mind in all its operations. It is not automatic in any sense. All we can say is: "that is the way we think. Whether other minds in other worlds think so or not we do not know."

But we hear some one say: "All those creations you have been talking about have been made by the mind." Quite true! Perhaps it is the distinctive mark of Mind that it can create. Perhaps Matter is that which is under the sway of Cause, and Life that which is under the control of Purpose, while Mind is the Spontaneous, the Free, that which is able to create its own world, indeed create itself. Were that the case we could understand why it is that the study of Cause and Effect does not reveal to us Mind; why the consideration of Purpose and Result leaves us with a vague feeling that something has been left out of the account. We may better use the term Spirit than the term Mind, as describing the subtle essence which is continually escaping into new forms, flowering in new designs. What

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if it be that so far as Spirit has existence it creates it for itself? The Spirit becomes non-existent as it ceases to create? If that be true then Spirit controls Purpose, and wields Cause for its own ends. What if it be true that even Life is to some extent always Spirit and a creator, spontaneously appearing in new forms with new purposes and new powers? Does not the whole history of Life on our planet warrant such conclusion? Is there anyone today who can say that new species, new forms of life did not arise spontaneously? What if it even be true that in a very minor way, yet still to some extent, even what we call matter is Spirit and has at times spontaneously taken new forms? When did the energy get into radium? When were all the various atoms formed and how? When did the ultimate protons come together in such intricate forms and with such an enormous energy content locked up in them? If the universe is running down how did it get wound up in the first place? Who built Uranium? What cause was able to bring about such an atom, and is no longer able to maintain it?

Because we have found there are causes, should we conclude there is nothing else? The Mathematician says we have strong warrant for concluding exactly the opposite, for causes run in systems, and we may conceive of different systems, and that in itself has produced entities which are not causes. Because we have found purposes, should we conclude there are only purposes? The Artist says that purposes are the outcome of visions, and visions are ever arising to bring new purposes, and the visions are not purposes. The tendency nowadays on every hand is to find that after all there is a Unity in the Universe. Life is found to imply Mind, and Matter seems to have qualities of Life, perhaps of Mind. The long-sought unity may then lie in the Spirit which is immanent in all of them.

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That sages and philosophers have had this conception in days long past is no reproach to it. Lucretius dreamed of atoms and Pythagoras of a universe built on integers, and were their dreams unrealizable? Modern science is scarcely in a position to assert they were. It may be that when the active spirit of Man was not weighted down with the accumulated knowledge of the centuries, when it was free to take a fresh and naïve view of itself and the universe, it saw with a clearer vision some of the fundamental entities of the universe than it does now after its long struggle to construct within itself a microcosm fully adequate to match the macrocosm. Eating of the tree of knowledge may not have been such a blessing as it might seem. And when more knowledge is gained by the sweet of the brow and midnight oil, is it so likely to be reliable as that first fresh unobstructed view when the morning-stars sang together?

When we attain the peak of the mountain we see the pattern of the world laid out below. The sun is sinking over the Sangre de Cristo range, touching its edge with a crown of glory. The rich shadows creep out across the plains, turning the gray veil of the sage to a royal purple mantle. The beating sand waves of the arroyo have become yellow flames of living fire. The far distant horizon takes on a delicate translucent green. The puff of white smoke is now almost inside the checkered diagram of the summer city. We see the sun, the mountains, the plains, the sky, shot through and through with the filaments of Cause, the thronging street with the flitting butterflies of Purpose, just as before, but there is a new element in each. For we can sweep backward over the long, long history of the mountain and the plain and perceive a design, a purpose in its evolution. We can almost remember the causes which led to the building of the city. And through both causes and purposes we perceive the elusive spirit which

is ever bursting into new forms, like the spray of the ocean wave, the evanescent mists that play above the mountain top. It flowers in the harebell and the columbine, it sings in the cascade, it floats on the empyrean with the eagle, it comprehends with the Poet. And Spirit ceaselessly creates not from cause nor for a purpose, it is FREE.

The wondering soul has spun a thread,
To sail a-dreaming, dreaming.

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BIOLOGY AND SOCIOLOGY

THERE are many facile comparisons to be drawn between the facts of biology and sociology. The most obvious is that between a whole civilized community and one of the higher animals. Shakespeare employed an age-old fable in Menenius Agrippa's Tale of the Belly and the Members in Coriolanus. With Darwin, and the establishment of evolutionary biology on a sound footing, matters took a new turn. Man was now seen to be connected with the rest of life not merely by analogies of his own mind's weaving, but by the living bonds of genetic descent; and it was at once perceived that a more rigid force than had hitherto been suspected might inhere in the comparisons between State and organism. For, as Spencer argued, was not the State in a true sense an organism—a single biological unit composed of individual human beings just as a matazoan animal was a single biological unit composed, in the first instance, of individual cells? Further, the investigation of the evolutionary process seemed to reveal certain general laws of its march: beings of the same original constitution, exposed to the environmental forces of the same planet, had reacted in similar ways, developing along parallel lines and arriving at similar types of organization as end-result. Thus it might reasonably be supposed that we should find the same general organization and mode of development in one type of or-

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organism as in another, in human society as in a vertebrate.

On these bases, Spencer and his followers drew elaborate comparisons of the two, and apparently believed that they were reaching the same degree of accuracy as that found in comparative anatomy when they compared the circulatory system of a mammal with the transport facilities of a State, or drew parallels between the brain and the cabinet.

It was speedily seen, however, that such generalizations were so broad and vague as not to be of much service: that the resemblances were in fact often no more than symbolical or metaphorical, instead of being based upon detailed similarity of constitution or of evolutionary development. With this, evolutionary theorizing on sociological matters fell somewhat into disrepute. The earlier jubilant certainly gave place to later doubt; and the half-century whose beginnings had roused Haeckel and Herbert Spencer to their imaginative flights closed suitably enough with that remarkable document, T. H. Huxley's Romanes Lecture, in which the greatest protagonist of Darwinism confesses to seeing between man and the rest of the cosmic process, in spite of man's genesis from that same cosmic process, an insuperable and essential opposition, a difference of aim or direction which had turned the original bridge into a barrier.

As a result, not only did the particular comparison between society and an organism fall into disrepute, but also all attempts to draw far-reaching conclusions from biology to human affairs.

But the original contention still remains, and is logically unassailable. Man is an organism descended from lower organisms; his communities are composed of units bound together for mutual good in a division of labor in the same way as are the cells of a metazoan; he can no more escape the effects of his terrestrial environment than can other

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organisms. There *is* therefore reason to suppose that the processes of evolution in man and man's societies on the one hand, and in lower organisms on the other, must have something important and indeed fundamental in common, something which if we could but unravel would help us in the study of both.

The correlation of biology with sociology is important not only in itself, but also as part of a more general correlation of all the sciences. The correlation of the sciences is of particular importance today for a double set of reasons.

The rise of evolutionary biology and of modern psychology have not only changed our outlook on specially human problems, but have altered the whole balance, if I may so put it, of science. There was a time when the basic studies of physics and chemistry seemed not only basic but somehow more essentially scientific than the sciences dealing with life. Distinctions were drawn between the experimental and the observational sciences—often half-consciously implying a distinction between accurate, scientific, self-respecting sciences and blundering, hit-or-miss, tolerated bodies of knowledge. Biology is now, however, seen to be every whit as susceptible of accurate and experimental analysis; and indeed to present so many problems to the physicist and chemist that in fifty years or so, I venture to prophesy, the wise virgins in those basic sciences will be those who have laid in a store of biological oil.

But the main point is this—the study of evolution, of animal behavior and of human psychology make it clear that in the higher forms of animals at least we are dealing with a category not touched on at all by the physicist and chemist—the category of mind and mental process. Sir Charles Sherrington, with admirable lucidity, drew for us, in his recent address to the British Association, the problem of the relation between mind and matter as it presents itself to the biologist.

The great change that has come over science in the last half century, or so it seems to me, is the recognition that mind is not to be explained away as a mere epiphenomenon, but is to be studied as a phenomenon. From this point of view, biology will always be the connecting link between physico-chemical science on the one hand, and psychology on the other. There is every reason to suppose and no reason to doubt that life, which we know to be composed of the same material elements and to work by the same energy as non-living matter, actually arose from it during the evolution of this planet. There is, in the behavior of the lower organisms, nothing which by itself would make us postulate mind: but in the higher insects, molluscs, and vertebrates, the last in particular, mental process is not only clearly present, but clearly of great biological importance, and finally the mind of man, according to innumerable converging lines of evidence, has evolved from the mind of some non-human mammal.

The principle of continuity makes us postulate that this new category of phenomena has not sprung up during the course of evolution absolutely *de novo*, but that it is in some senses universally present in all phenomena. It is merely that we have not yet found a method for the direct detection of mental processes as we have, say, for electrical processes; but something of the same general nature, the same category as mind must, if we wish to preserve our scientific sanity, our belief in the orderliness of the world, be present in lower organisms and in the lifeless matter from which they originally sprang.

In the present state of our knowledge, the study of physics and chemistry can be pursued without any reference to mental processes. But the study of biology cannot: and that is one reason why the center of gravity of science as a whole is shifting—it is shifting for exactly the same reason that the center of gravity of a house shifts

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during its construction: because the foundations have to be built first.

Our second reason is as follows: Biology is once more the link between root and flower, between physics and chemistry and human affairs, in regard to evolution, or, to put it in a slightly different way, in regard to the directional processes to be seen in the universe. So far as a main direction is to be observed in physics and chemistry, it is, as all authorities are agreed, towards the degradation of energy and a final state in which not only life but all activity whatsoever will be reduced to nothing, all the waters of energy run down into a single dead level of moveless ocean. Biology, on the other hand, presents us with the spectacle of an evolution in which the main direction is the raising of the maximum level of certain qualities of living beings, qualities such as efficiency of organs, coördination, size, accuracy and range of senses, capacity for knowledge, memory and educability, emotional intensity, which in one way or another lead to a more efficient control by the organism over the external world, and to its greater independence.

A direction towards more mind is visible, and this development of greater mental powers has been the chief instrument in all the later stages of acquiring control and independence. More and more of matter is embodied in living organisms, more and more becomes subservient to life.

Thus, while in physics and chemistry we see a tendency towards the extinction of life and activity, in biology we see a tendency towards more life and more activity; and this latter tendency is accompanied and largely made possible by the evolution of greater intensity of mental process —of something, that is to say, that we cannot as yet take account of in physics and chemistry.

The biologist may well ask himself the question: "Is it not possible that this evolving mind, of whose achievements

on its new level in man, we are only seeing the beginning, may continue to find more and more ways of subordinating the inorganic to itself, and that it may eventually retard or even prevent the attainment of this complete degradation of energy prophesied by physico-chemical science? Is it not possible that this great generalization only applies to phenomena in their purely material aspect, and that when we learn to detect and measure the mental aspects of phenomena, we may find reason to modify the universal applicability of this law of degradation?" We do not know the answer to that question: but it is clearly a legitimate and useful question to ask. In any event, we constatate two chief directions in the universe; that seen in biology is in many ways opposed to that seen in physics and chemistry; and both must be taken into account.

I have spent, I fear, a great deal of time on what will appear to many as very irrelevant prolegomena. But the complete breakdown of the older views about nature and man, of the philosophies and theologies based not on observation but on an authority which is no authority, or unverifiable speculation, on superstition, and on what we would like to be so rather than on what happens to be—the breakdown of all the commonly accepted basis for man's views of himself and the universe has made it necesary to go back to fundamentals if we are to see where we stand. Secondly, the progress of the biological and psychological sciences, as I have already pointed out, has considerably altered the outlook of those who pin their faith to the newer or scientific view of nature, the view which attempts constantly to refer speculations to reality, and to build on foundations which have been tested by experiment.

The orthodox evolutionary view was that phenomena received in some degree an explanation if their origin from simpler phenomena could be demonstrated. As a matter of fact, reflection makes it clear that such an explanation

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is never complete. It is a very incomplete explanation of the properties of water to discover that it is composed of oxygen and hydrogen; or of those of humanity to discover that it is derived from lower forms of life. A precisely similar mistake is made by most psycho-analysts, who consider that an explanation of adult psychology is given by tracing in it effects of the events of childhood. In all such cases it is true that analysis is helped, but we are by no means exempted from further study of the later, more complex phenomena in and for themselves. Just as adult psychology is qualitatively different in various respects from childish psychology, so is man qualitatively different from lower organisms. Very few attempts have been made to carry over conceptions derived from sociology into biology.[1] But the converse, as we have seen, has often been true, and numerous writers—largely because purely biological are simpler than human phenomena—have been obsessed with the idea that the study of biology as such will teach us principles which can be applied directly and wholesale to human problems.

What we have just been saying shows us the correct path. Through psychology and biology, sociology can become attached to the general body of science; and in so doing it can both receive and give. Since man is but a single species of organism, and, biologically speaking, a very young one; since moreover, he presents a peculiar type of organization, it is clear that the broad principles underlying physiology and evolution can best be studied on other organisms and later applied to man. On the other hand, man is the highest existing organism; thus a study of the causes to which he owes preëminence will be important as adding to and crowning the principles derived from non-human biology. Furthermore, not only are man's mental powers on a different level from those of other animals,

[1] Morley Roberts is a recent exception. See his interesting book, *Warfare in the Human Body;* Nash, London, 1920.

but psychology can at present make by far its greatest contributions by a study of human mind, so that the psychological side of biology will for the present derive its chief information from man.

Our first affair, therefore, is to see in what important respects man is qualitatively unlike the rest of the organic world; then to investigate what general rules or principles apply equally to him and to the others; and finally to see what corrections, so to speak, must be made before these principles can be applied to the one or to the other.

The qualitative difference between man and other organisms is a cardinal fact which orthodox biology has tended to slur over or to neglect, whereas philosophy has too often tried to magnify it unduly so as to make man frankly incommensurable with his lower relatives, a creature not only unique but disparate.

Man is obviously and undoubtedly an organism. He possesses the same general system of organs, working in the same way, as a dog, a horse, a bird, a crocodile or a frog; he passes through the same type of development cycle; he is built on the same detailed plan as other mammals, and numerous indications betray his descent from a particular branch of the mammalian stock.

But in his mode of life and type of social organization he is unique. All detailed comparisons between the communities of man and those of bees and ants are as unprofitable in the working-out as they are easy in the making. It is futile to direct the sluggard or any other human being to the ant, since the whole physical and psychical construction of ants is different from that of men, the whole organization of their communities from that of his.

His mode of life is unique because his psycho-neural mechanism is built on a new plan, new modes of connection between parts of the brain being associated with new possibilities of mind. Let us briefly run over the biologi-

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cally most important point in which he differs from the lower organisms.

In the first place, he is capable of speech, and possesses a true language—not a mere repertory of sounds or signs associated with different states of mind as in some higher organisms, but a language comprising special symbols for particular external objects, and thus making it possible to have a much more detailed knowledge and classification of the outer world. In the second place, he can frame abstract ideas or concepts, and is thus enabled to extract the general kernel from the husk of innumerable separate and different particulars. As a result of these two faculties, he possesses what we may call a new, accessory form of inheritance. True biological inheritance takes place by means of the reproductive cells. In some birds and mammals, the behavior of the young is modified by what they learn from their parents, so that they profit by the experience of their elders; however, this profiting by experience is not cumulative, but must be repeated afresh in each generation. In man, on the other hand, speech and writing make it possible to construct a continuous tradition, by means of which experience may be actually accumulated from generation to generation. There are thus two forms of inheritance in man, two hereditary streams—biological inheritance, by means of germ-cells or detached portions of the organism, in which favorable mutations may be accumulated by selection, and "experience-inheritance," by means of tradition, in which useful experience may be accumulated by the activity of mind.[2] By means of tradition-inheritance, man is virtually enabled to "inherit acquired characters"; thus the environment in which the latter stages of his development are passed through, and consequently his adult self, the end-product of that development, can be altered far more rapidly than in any other

[2] In a further discussion of tradition-inheritance from a broad biological point of view, see Carr-Saunders, *The Population Problem*, Oxford, 1922.

organism. Finally, it is possible, as is being increasingly realized, thus to accumulate experience relating to the alteration of biological inheritance, and so eventually to substitute conscious purpose for blind natural selection in man's future evolution.

Next point: by means of speech, tradition, and invention, man has been enabled to extend his biological environment —in other words, that part of the cosmos with which he stands in relation—till it has reached an enormously greater size than that of any other organism. He is learning ever more facts about the celestial bodies, studying stars that are at an inconceivable distance from him. He is able to travel at will to all parts of the globe. He can penetrate by means of tradition to remote periods of the past: as Mr. Wells has forcibly put it, a modern Englishman can know more of the world in the Classical Epoch than could the most learned Greek or Roman. And even when he can no more get into contact with ideas, he can still unravel facts: flint implements help him to the history of man, fossils to that of life, rocks to that of the globe, stars to that of the solar system. In time, as well as in space, his environment enlarges to a size that is for practical purposes infinite, whereas no other organism can penetrate beyond its own memories, or, at most, do more than profit by those of the generation immediately before it. Professor Keyser,[3] in a suggestive article, has characterized this unique attribute of man by calling him "the time-binder."

Speech and reasoning, with all their consequences, have only been rendered possible through another important qualitative change in the human brain, which in its turn has led to other new potentialities of life being realized in man and in man alone—its flexibility.

[3] *Science*, Sept., 1921.

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In some of the lowest forms of life, such as Paramecium there are but one or two possible modes of reaction—reactions which it attempts in response to any one of the myriad changes that may occur in the outer world. As we ascend the scale, we find two chief types of alterations: in the first place an increase in the number of hereditarily-given modes of reaction, and in the second an increased power of "learning," of altering behavior in adjustment to experience. In the insects, the first is chiefly in evidence. Although many insects undoubtedly can profit by experience to a limited degree, yet most of their behavior is instinctive, in the sense that it unrolls itself automatically and efficiently in the absence of previous experience or of any possible instruction. In the vertebrates, on the other hand, we see as we pass from the lower to the higher groups a definite, steady increase in the power of learning by experience from the fish that takes weeks to associate a given color with a given event such as feeding-time, to the dog or monkey capable of learning elaborate tricks after a couple of trials. But even in the most "intelligent" of birds or mammals, the power of image-formation is very probably absent,[4] and the power of concept-formation, of generalizing, certainly so. This fact (quite apart from the absence of tradition, although this, too, operates in the same direction) means that the associations of animals can only be arbitrary and individual: a rook in one country (to choose a somewhat far-fetched example) may happen to associate danger with fire-arms, one in another with bows-and-arrows. Life, for the animals, is a cinema, different for each individual, in which one event may be associated with another in the most diverse and haphazard ways. With the advent of the human type of brain, however, experience can be sorted out and properly docketed; the more cinematographic record is converted into a drama full of signifi-

[4] See Thorndike, *Animal Intelligence*, Macmillan, New York, 1911.

cance, the diary into a card-index. By this means, and by tradition, it is possible for man to obtain a much more accurate and more complete grasp of the relationships of the objects that compose the outer world than is possible for any other animal. Through knowledge, as ever, comes power: and as a result, man has been enabled to invent tools and machinery, and so to enlarge enormously his control over his environment. Just as his "range," in the zoögeographical sense, is extended to an unprecedented degree both in space and time, so tools represent, biologically speaking, an extension of himself as an operator. While man is using a tool, he and the tool together constitute but a single unit in the struggle for existence. As various writers have put it, tools and machines are temporary organs of man, which have the additional merit of being replaceable if lost or damaged.

But this is not all: the great power of association possessed by man, together with his faculty of generalization and of speech, makes it possible for him to *learn* his rôle in the community, instead of being born with it as are the bee and the ant. Great educability instead of differentiated instinct; infinite possibility, at the expense of the pains of learning, instead of an effortless but limited stock of inborn modes of behaviour—in this again man represents a qualitatively new organic type.

By this means, he can escape what has always been a necessity with lower forms: by means of education and machinery he can play a specialized part in the community life, and so build up a community with a high degree of division of labor, without being born specialized. He could not thus learn his rôle if he were not educable, nor if he could not manufacture tools. An ant or a duck or a dog possesses admirable tools for its particular job: but they are living parts of the organism's own body. A worker ant cannot lay down its serviceable carpentering mandibles

and become a soldier by picking up a large war-like pair: once a worker, always a worker; once a soldier, always a soldier,— that is the rule for ants, but not for men.

The efficiency and biological success of communities depends on the degree and accuracy of the division of labor and coördination between the units of which they are built up. This is true of cell-communities and the second-grade individuals or metazo or multi-cellular animals and plants to which they give rise,[5] and also of the communities or metazoa and the third-grade individuals to which they give rise, whether the members of such communities of higher grade are physically bound together, as in a Hydroid or a Portuguese Man-o'-War, or united only by mental bonds, as are the communities of ants and bees and termites. As we have seen, the individuals are differentiated structurally for the different functions which they have to perform.

This is not so in human species: a man is not born cross-legged to be a tailor, or broad-thumbed to be a miller, or huge-armed to be a blacksmith. Even in the hereditary castes of India, the trade or profession is determined by tradition, and not by inborn structural adaptations.

Still another consequence flows from this educability, this flexible and elastic mental organization. A man can pass from one occupation to another. He can be specialized for several, or combine a high degree of professional skill in one with the generalized knowledge of an amateur in another. It is this obvious but fundamental fact which is at the bottom of many of the failures to apply biological ideas to sociology.

Another human distinction is the increase of the part played by environment in man as opposed to animals (in determining his biologically effective nature). Environment plays not merely a large part, but a preponderating one, in his development after the first year or so of his

[5] See Huxley, J. S., *The Individual in the Animal Kingdom*, Cambridge, 1911, for a discussion of the grades of biological individuality.

life. Tradition provides a special environment, made by man for man's own development; and men brought up in markedly different traditions arrive at different end-results just as surely and obviously as do men of markedly different hereditary tendencies arrive at different end-results even though exposed to similar traditions. Traditions are infinitely complex things: there are world-traditions, national traditions broad and narrow, class traditions and traditions of profession and trade, traditions of predilection, of art, of religion: and men may be exposed in their development to the combined influence of a number of these. But the net result of the diversity of tradition is an extraordinary diversity of end-result. *"Nihil humanum alienum a me puto"*—Terence could only say this with truth in the sense that there are certain fundamental emotions and instincts found in all men, and also certain aspects of environment shared by all humanity—the sun and moon, earth, water and fire, space and time, parents and society, and so on and so forth.

I make no apologies for the length of this preliminary analysis, since it is precisely by the neglect of preliminary analysis that most attempts to correlate biology and sociology have failed. The salient fact emerges that with man there has been a radical change in evolutionary method.

As space is limited, I am only proposing to consider here three of the chief contributions which biology can make to sociology—on the idea of progress, on the relation between individual and community, and on the applicability of the doctrine of the struggle for existence to man.

As regards the idea of progress, biology can make a clear and unequivocal contribution; whereas man is biologically so young, his evolution as yet so chaotic and divergently directed, that it is very hard to arrive at definite conclusions from a study of his history alone. It has been a source of constant surprise to me that more use has not

been made of biological data in the controversy over this question. In the little book recently edited by Mr. Marvin on various aspects of the concept of Progress, there was no article dealing with biological progress; and even in Professor Bury's notable book, *The Idea of Progress,* biology was as little and as unsatisfactorily drawn upon as in Dean Inge's writings on the subject.

We have already seen that a certain direction obtains in organic evolution. Into the details of this process I have not here the time to go; we must be content with the brief enumeration which has already been given of the qualities of organisms whose maximum level, and to a lesser degree whose average, have increased during evolution.

So far so good. But a process may be going in a definite direction and yet not be satisfactory.

This road leads to London; this other to Puddlington Parva. We all know people who are obviously headed for success, while it is on record that Mr. Mantalini's direction was towards "the demnition bow-wows."

But we know that we ourselves consciously find *value* in things, in objects and aims, in directions and processes. In this, we are unique among organisms, and as a matter of fact a large part of our life is determined by the relative values we set on objects. On the whole, however, there is a reasonable amount of agreement among different individuals, at any rate in one country at one epoch, as to what they call good and what they call bad. There are very few western Europeans who find dirt or untruthfulness good, knowledge or bravery bad.

When we look into the trend of biological evolution, we find as a matter of fact that it has operated to produce on the whole what we find good, to bring into being more and more things on which we can set positive value. This is not to say that progress is an inevitable "law of nature," but that it has actually occurred, and that its occurrence

provides an external sanction for many of our subjective human hopes and ideals.

True, that we are ourselves a product of the evolutionary process and might therefore be thought biased. None the less, it is clear that if a degenerate animal like a tapeworm, or one inevitably specialized like a hermit-crab, could possess and enunciate values, they would be of a very different nature from our own. But we should further find that the direction of the evolutionary process which led to the former was directly opposed to the main trend, that of the latter more or less at right angles to it. The general coincidence of the main observable trend and of our own concepts of value warrants us in calling the one progressive, and in feeling that the other is no mere isolated flicker in an alien or hostile world, but finds a sanction and a resting-place in being part of something vastly bigger than itself. The remarkable and important fact for man is to find, in spite of all the apparently fundamental differences between his organization and his evolutionary methods and those of lower organisms, in spite of the widespread degeneration and "blind-alleyism" to be seen in evolution, that the direction in which he desires to go coincides with the resultant, the main direction of organic evolution. There are no ideals, there is no purpose, in fish or ant or tree: but man's ideals and purposes are the outcome of the blind interplay of forces in which fish and ant and tree play their unwilling rôles. True, again, that further analysis shows that the methods of evolutionary progress are often crude, wasteful and slow: that some of our values are unreal or artificial: but this does not destroy the main fact, and only means that each side can here learn something from the other.

The main fact abides—that progress is an evolutionary reality; and that an analysis of the modes of biological

progress may often help us in our quest for human progress.

The next great problem on which biology has something to say to sociology is that eternal one of the relation between individual and community. As it is sometimes put, Does the individual exist for the State, or the State for the individual? In all non-human biological aggregates—cell colonies, second-grade aggregates or metazoan colonies, third-grade aggregates like Siphonophora and insect communities—the very existence of the aggregate as a unit, its biological efficiency and success, depend upon a permanent division of labor between its members, upon their thorough-going specialization. This always and inevitably involves a sacrifice of certain of their potentialities to greater efficiency in one or a few actual functions, and in evolution a progressive subordination of the smaller unit to the aggregate.

At first sight, Biological principles seem to contradict themselves on this subject. On the one hand, the human individual is, or, we had better say, has the potentiality of being the highest type of organism in existence—far higher, biologically speaking, not only than any human community now in existence, but than any which we could possibly imagine as coming into existence in the future. When we remember the general agreement of biological progress with our human values (p. 17), it is clear that to degrade the individual for the benefit of the community is wrong—a biological crime.

On the other hand, human progress depends and will always depend to an extent scarcely to be overrated upon the proper organization of the community. So long as present competition continues, the very survival of a nation may easily depend upon the efficiency of its organization as a community. Biological as well as human experience make it perfectly plain that such success, in a unit which is itself

an aggregate of smaller units, depends upon the degree of specialization of these constituent units and the division of labor and coöperation between them.

Biology here then lays down that human individuals should become more and more specialized if progress is to continue; but since specialization implies the sacrifice of many potentialities for the good of the whole, this apparently contradicts what we have just inculcated above.

This is where our human flexibility comes in. Man should neither live whole-heartedly for himself, nor throw his individuality, ant-like, beneath the wheels of the community Juggernaut. He can escape from the dilemma by passing from one state to the other. For part of his time, he can apply his energies as a specialized unit—for the rest, he can be a complete individual, realizing the various potentialities of his many-sided nature, with the community contributing to his development, not he to the community's. And not only can he, but he should act thus.

Be it noted, to avoid misapprehension, that I have here been using the community to denote the single aggregate unit which from the beginning has played such an important part biologically in human evolution, not merely as denoting the sum of individuals considered separately.

Thus biology gives a definite answer to this question, too. Pure individualism is condemned, and so is what we may call ant-and-bee socialism. Some form of the "dual day," to use a current phrase, or at least of the "dual life," is the method which seems to be in accord with the enduring principles of biology, although the precise details are not and cannot be the biologist's concern.

I have reserved to the close that biological principle which has been most often and most seriously misapplied in sociology and politics—the struggle for existence. Never was the proverb about the Devil's quoting Scripture better exemplified than in this matter. This fundamental idea of

Darwin's has been used as justification for three totally different and indeed incompatible political doctrines. In England, it has served chiefly to bolster up *laissez-faire* individualism and free competition. In Germany, in the three years immediately succeeding the publication of the *Origin of Species*, it was seized upon by the Socialists as implying equal opportunity for all as against feudalism or hereditary aristocracy. Later in the same country (and to a certain extent elsewhere) it was abundantly employed as a theoretical support for militarism.

As a matter of fact, the use of it as sole principle governing the interrelation of biological units is wholly unjustified. As has been shown by a number of writers, among whom may especially be mentioned Darwin himself, Ritchie in his *Darwinism and Politics*, and Kropotkin in his *Mutual Aid*, the struggle for existence is only *one* of two possibilities in this relationship: the other is that of coöperation, of mutual aid, which is especially well marked in the building up of higher-grade units from a multiplicity of smaller lower-grade ones. Two of the most important steps in the whole evolutionary process have been based on the coöperation of units—the origin of multicellular from unicellular organisms, and the development of true man, with his social life, from his prehuman ancestor. It is also prominent in the lives of many species of the highest groups—insects, mammals and birds: witness the ants and bees, the rook, the wild dog, the elephant, the baboon. In fact, once the bodily specialization of units has reached a certain pitch, progress, as we have seen, is only possible through mental development and this in the great majority of cases brings about aggregation into some sort of community, held together by mental bonds.

Besides aggregation of similar units, there has frequently been coöperation between units of unlike character and origin—witness Symbiosis, as in lichens; the relation

between many insects and flowers; the formation of flocks consisting of two or more species, as with jackdaws and rooks, and many other cases.

Competition and coöperation both occur throughout the whole of evolution: but coöperation comes to play an ever more considerable part in higher forms. In lower organisms enormous over-production is of no great consequence; their organization is simple, and, given favorable conditions, they can turn inorganic matter into their own specific substance at a great rate. But higher forms are more complex, more delicately-balanced, and longer-lived. Accordingly, waste of life is of greater consequence to them, and methods by which a struggle on the grand scale can be minimized tend to be more and more adopted. We find regularly, for instance, a reduction of the number of offspring in higher groups together with greater parental care.

Thus coöperation, for still fresh reasons, is biologically important for the higher groups. The problem is becoming increasingly pressing for the human race, since the time is in sight when the whole habitable area of the globe will be colonized, up to a certain level of density and efficiency by members of the more advanced races. Biologically speaking, it is perfectly clear that some coöperative system, involving federation in one form or another, is the proper system to adopt; and that the "world-state"—not necessarily organized after the plan of our present highly specialized nationalist-industrialist states, which appear happily to represent only a temporary phase of evolution, but none the less an organic reality, a coöperative unit—that the "world-state" is not merely a figment of unpractical dreamers, but an obviously desirable aim for humanity.

To sum up, we may say that the crude application to human affairs of the doctrine of the struggle for existence, torn from its biological context, isolated and over-empha-

sized, is wholly unwarranted. On the other hand, a struggle does continue, both of the direct and indirect type defined by Darwin; and there is no prospect of it ceasing to play an important part in human biology. Coöperation is not, any more than competition, to be taken as the sole desirable principle. Panaceas of this sort do not exist, except to make bubble reputations and quack fortunes. Even within such a highly organized coöperative unit as the mammalian body, a struggle continues—the different tissues are in competition with each other for food, and if the available supply diminishes below the necessary level, some tissues will be drawn upon by other more successful competitors, and the struggle will lead to an end-result in which the proportion of the various kinds of cells comes to be very different from what they were in the normal well-nourished body. That is a purely biological example. In man, since the unification of the community is of a low order, it is inevitable that individuals and sections will continue in some form of competition with each other: not only this, however, but the additional fact that man's mental organization reacts strongly to the stimulus of competition make it probable that a "struggle" of some sort will not only be inevitable but up to a point beneficial in any form of society. What is more, once coöperation exists, competition between the units that coöperate is necessary to bring out the full efficiency of their combination.

All that the biologist can do is to point out that neither the one-sided application of the principle of struggle nor of that of coöperation is biologically sound. But, as everywhere else in human conduct, after the broad principles have been grasped, success lies always in a delicate, continuous adjustment of conflicting claims, in what one may call a personal conscious effort. Struggle is universal: but alone it can only lead to a certain stage of evolutionary progress.

The half-baked moralist may lay down the law about right and wrong with the most positive assurance; but, by not paying attention to the necessity for sweet reasonableness, give-and-take, unselfishness, for thought about the thousand-and-one details of daily conduct, he may be making himself and his wife thoroughly unhappy and ruining his family's chances, and, as a matter of fact, be thoroughly immoral without once suspecting it.

It is in a very similar way that the militarist, for instance, fortifying himself in the doctrine of the struggle for existence, with what he regards as an impregnable sanction for his theories, is in reality acting immorally because not attempting to envisage the whole problem.

There is one very interesting evolutionary incident which well illustrates the difference between pure biology and pure sociology, and yet emphasizes the natural connection between the two. Once again, it has a connection with the greater flexibility of human mind. As we have seen, in the lowest animals, behavior is for the most part unvarying, hereditarily determined: the organism is capable of a number of definite reactions, and if these do not suffice to extricate it from difficulties, it perishes. The first step towards gaining is the power of learning. "Once bitten, twice shy," is a proverb applicable to all higher vertebrates; and it is not only the burnt child who dreads the fire although a study of moths and candles will convince us that a burnt "Lepidopteran" cannot be substituted.

When, as in the higher mammals, the power of learning by experience is rapid, the individual organism is better able to adjust itself to the dangers of life, and once more there is less sacrifice of individuals in the struggle. The same organism persists: but of two possible types of behavior, the unmodified innate type is eliminated, the type modified by experience survives. If we like to put it in a way which is perhaps not wholly justifiable, there comes

into being, besides the struggle for existence between individuals, a struggle for existence between different possible modes of reaction of one and the same organism.

With the advent of man up the scene, new possibilities arise. First of all, he is capable of ideas, which, biologically speaking, are to be regarded as potentialities of behavior. There is no evidence at present that even the highest animals possess ideas or even images.[6] Secondly, these ideas are transmissible by speech and writing; and accordingly *tradition* has come into being, so that modification of behavior by experience can be operative not only within the individual life, not only from one generation to the next immediately succeeding, as in many mammals, but for an indefinite period. The experience of Moses, Archimedes, or Charlemagne, of Jesus, Newton or James Watt is modifying our behavior today.

The result, both for individuals and communities, is that a selection of ideas instead of a selection of organic units can to an ever greater extent take place; and thus the actual extinction of living matter be increasingly avoided. For instance, we find the substitution of judicial procedure, in which the ideas of two disputants about the matter in dispute are weighed and a selection made in favor of one, for various forms of violence and combat in which one or other of the actual disputants was often eliminated. Or, again, in struggles between communities, even though warfare is still resorted to, yet it does not operate in the same way as in earlier stages of human evolution. A particularly salient example of this is afforded by the result of the recent war to Germany; although an equally good instance can be seen, for example, in the Boer War. In primitive wars, the defeated tribe was wherever possible exterminated or enslaved: it ceased to exist as an independent unit, and the great majority of its male members were

[6] See Thorndyke, *op. cit.*; Washburn, *The Animal Mind*, New York, 1913.

killed. This is impossible under present conditions: and all those who preserve, or have every possessed, any political sanity aim, for instance, neither at the physical nor the economic subordination of Germany, but—to use one of those attractive catch-words that sounded so well in war time—at her "change of heart"—in other words, the extermination of one national tradition, the building up of another.

To what extent this substitution of mental for physical will continue it is hard to say; already, to take another field, the multiplication of cheap books has led to an ever increasing number of men and women finding most of their adventure and romance in books instead of in the life that we are accustomed to call real. But what would lead us away from our main point—enough to have indicated another great difference between processes above and below the human level.

There are numerous important questions concerning our right to apply biological ideas of heredity directly to human beings which I would have liked to touch upon. But for one thing I have not the time, and for another, Mr. Carr Saunders in his recent book on the Population Problem, has dealt so fully with the relation between biological inheritance and what may be called tradition-inheritance, that I omit them with a good conscience.

In this brief treatment I have had to ask you to take conclusion on trust, without presenting the evidence on which they are based; this, however, is inevitable when transferring ideas from one science to another. I have attempted to show first that biology can profit by incorporating certain conclusions of sociology and so rounding-off and completing certain of its own principles: on the other hand, I have put before you my belief that there are certain basic biological principles which must be taken into account

by the sociologist—principles which hold good in sociology because man too is an organism.

By now, however, we can see more clearly the way in which the various sciences with which we are concerned, of whose relations we had something to say at the beginning of this essay, properly interlock.

They interlock thus. The physico-chemical sciences are basic to biology. Organisms are made of the same substances as are non-living compounds; their processes are therefore conformable to certain physico-chemical laws, such as the indestructibility of matter, the conservation of energy and so forth; and in so far as we analyze the material aspect of life, physico-chemical concepts are *adequate*. On the other hand physico-chemical concepts—or at least our present ones—are not *sufficient*. In the first place, the very complicated arrangement of matter which is found in living substance has not been yet sufficiently analyzed by physics and chemistry: accordingly we find many processes occurring in biology—such as the directional changes in evolution of which we have spoken—which could not have been foretold on our present physico-chemical knowledge, but must be investigated separately as adding to our store of knowledge and principles, in the confident hope that a synthesis will one day be possible. Secondly, a whole new category of phenomena, the psychological, is first met with in biology, and to this we cannot as yet apply physical or chemical ideas at all.

For a combination of these two reasons, biology deals with certain concepts which are not implicit in current physico-chemical ideas. Physics and chemistry are basic for biology, but they are not exhaustive.

In a very similar way, biology is basic for sociology, but again not exhaustive. Certain limits are set to human life through man's organic nature. Certain of his activities can be completely analyzed in terms of biology. But other

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of his activities, especially those concerned with his new type of mental organization, find no counterpart in the rest of the biological kingdoms, and must be studied in and for themselves.

Bergson would have us believe that evolution is creative. It is better to say, with Lloyd Morgan, that it is emergent. With new degrees of complexity, new qualitative differences emerge. Thus the sciences are a hierarchy, the subject-matter of one constituting the foundation for the next in the series. All that biology can do for sociology is to help her to build her foundations solidly and correctly; but we all know that without good foundations no building is safe.

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A CRISIS IN SCIENCE

A Plea to All Scientists and to All Men for a Sound, Sane and Practical Union of All Intelligence, to the Welfare of Mankind

MY THESIS is that a crisis has come that places on every man a grave responsibility to understand it, and to contribute his full power to its conclusion. This duty rests specially on every scientist.

A main motto of science has been, "Hold till disproved." Since the Middle Ages, science has placed mainly on the innovator alone, the burden of proof and disproof. This was profitable for so long as the growth of science was infantile. But Science has grown to a crisis that demands the active interest and assistance of all her family and friends.

The crisis demands this because it involves the most elementary and fundamental conceptions upon which all other conceptions of science and mankind are built; because it now challenges the presumptions upon which all its practical work is done; and because the practical work of science can no longer be carried on with full measure of profit in any of its departments, until the challenge be met, understood and resolved.

The Michelson-Morley experiments regarding light and the ether, with the consequent Einstein promulgations flamingly advertised, are only a minor part of the challenge. They obscure and threaten the hitherto determinations of science, its working postulates, its future accom-

plishments, its fundamental reputation . . . all, well may be, only fallaciously. But the full crisis is constituted by enormously more important circumstances.

I will lead to an understanding of it by beginning with color. Newton was the first modern scientist who distinguished between light and color. From his discoveries regarding light he declared that the entire spatial world with all therein, and including all material things as well as light, are colorless; are not even black in the night; and that color, to use his words, "is a something added by the mind." Nevertheless, most men still unquestioningly believe all objects to be colored even when no eye sees them. Even Roland, then the greatest American expert regarding light, once contended against me, from a six o'clock dinner till six in the morning, that the light rays of the sun are so many colored streaks running from it to the earth. If you now look around you, you also will have difficulty in adjusting your immediate conviction to the belief that the colors of which you are conscious, are things added by your mind. And you will have greater trouble with color shape, color space, and color motion; and with the probable fact that all shapes, spaces and motions throughout the universe are essentially of this mental sort; and are of different patterns in every mind characteristically of the entire evolutionary history of each individual mind . . . or as Einstein would say, "relatively" to each mind.

Newton seems never to have suspected that the shapes and motions of which we are immediately conscious, are "added by the mind," as well as color. But less than a life time after Newton, Berkeley, from discoveries in optics destined to be of greater historic consequence than any of Newton's, deduced the sweeping conclusion that no world of space and shapely things, colored or otherwise, exists, such as science still tentatively assumes; and being a pious bishop, he jumped to the belief that only "spirits" exist any-

where. We shall discover Berkeley to have been amazingly right and amazingly wrong.

For almost 300 years from Berkeley nearly to our own day, professional philosophic opinion with overwhelming preponderance has held and taught what essentially is the Berkeleyan cosmology. And in this fact is one source of the present crisis.

The effect upon science of this philosophy has been in the highest degree unwholesome and deadening. Because not herself trained in such matters, Science has felt bound to recognize the expert authority of her sister; and officially to declare the fundamental postulates of science to be only "tentative" and probably false. And because of this slavish feeling, the practical work of science has proceeded only within conflicting limitation: has been cramped, stultified and vitiated.

The leaders of science have felt, some of them, that they were too busy to grapple with fundamentals; some that they were incompetent of the task; some that it was unimportant; and nearly all of them, in accord with the motto of science, have felt that it was none of their business.

The evil effects of this should be recognized by focusing upon England. For a hundred years her universities have been dominated by the Berkeleyan dogma that no spatial world exists; and that no matter, or ether, or motion really exists such as that to which science now inclines to reduce all its working conceptions. Almost all English scientists have grown up educated to this ultimatum. And its influence, consciously or unconsciously, has made impossible for their scientists to work out consistently either their own tentative postulates of practical physics, or any others. A similar situation holds in most other countries. But how expect any man to solve the problems of light, ether, matter, mass, and energy, as reduced to mere motion, for so long as the only conceptions of space and motion used, are

precisely those which as well "ultimate opinion" and most recent science forbid?

I will return to these problems definitely. But to clear the way, we need to take in mind more precisely this rational philosophy that for more than 300 years, has defeated the practical development of physics; or to so much of it as contradicts the "tentative" and still more the tacit assumptions of science.

A main postulate so concerned is, as I have said, that of the existence of a spatial world that contains all things whatsoever in the universe. Berkeley denied this; and the dominating bulk of philosophic opinion has denied it ever since, and has declared that this so-called world of space and spatial things is but imagined or conceived. Einstein is non-committal, therefore hopelessly obscure. But the Einstein text-book declares that as well this "spatial world" and all motion is thus purely conceptual and in fact has no existence. The crisis is in part a conflict between "spatial world" and "no spatial world." And a part of my thesis is to demonstrate the monstrously paralyzing influence upon practical science, of this conflict.

Discovery that the earth is round and moves around the sun, changed human belief. The postulates of science have changed continually. A major change was from vacuous space to the plenum and ether of present physics. And we may well consider whether, but for the paralyzing influence in question, physicists, by similar "common sense" changes, would have discovered an all-including world preserving every requisite feature of this "spatial world" without in fact being thus spatial. Corpuscular translation and color disappeared from light, and light remained. Phlogiston disappeared from heat, and heat remained. Vacuums disappeared, and ether replaced them. Matter, mass, energy, and ether now incline to resolve to one fundamental sort of spatial motion common to them all in one

universal fluid. Why, then, may not the postulates of physics again resolve in a way essentially preserving them, while not preserving the conceptions of motion and of a spatial world, hitherto held? Certainly Clark Maxwell gave hint of this in declaring that utterly different postulates would do precisely as well. And we shall see them doing enormously better.

Of the dogma that rationalistic "authority" holds regarding "phenomena," I shall say little. Most men, when they open their eyes, believe all the things they see, to be no part of their own minds. Berkeley declared these things to be parts of the perceiver's mind; to be its own sensations visual and otherwise. Such open-eyed and as well all other sensations psychology now calls "presentations." But rationalistic philosophers call them all "phenomena," and declare they do not exist in the same meaning that "egos" exist; and that these phenomena have absolutely no character of their own or save such as some observer bestows upon them. They declare that if you see my finger and thumb, these are not of themselves the one longer than the other; and that your mind by using a separate entity called a "relation," perceives that relation but not a longer finger. They declare something similar of all lines and geometric figures; and that no spatial phenomena exist of themselves or have any geometric character of their own . . . say like the unique character of an hypothenuse. Also they declare that if you see the digits of my hand, they are not of themselves five rather than a million, but are five only in so far as some mind performs a numerating act regarding them: and so on regarding all enumerable and measurable things, such as Einstein discusses.

The Einstein school of Relativity, in a woefully amateurish and befuddled attempt to be, yet not to be, "metaphysical," declares with Kant and Herbert Spencer, that material things have an existence and character of their own

that we, in this life, never can see or know. And the Einstein text-book declares contrastingly with rationalistic philosophy, that the "phenomena" of the rationalists, are not solely the products of the observing mind, but are "joint" products of the mind and of the unknowable things of Kant and Spencer: in short, the Einstein school gets its "relativity" from rational philosophy, and its physical world from the realm of the unknowable . . . thus multiplying the befuddlements of both; and exempling the evil influence of scholasticism upon science.

Just how five observers or egos can themselves be five, while my fingers can not; and just why observers among themselves can be many or few and in character the same, or different, while fingers, lines and geometric shapes can be many or few, long or short, flat or round, the same or different, only by adding a "relation" to them, is surely an abstruse problem. But I leave it, remarking: First, that we shall presently see William James in the field of psychology, because he could not free his mind wholly from his early rationalistic education and typically of the pernicious influence of rational philosophy on science generally, shall see him bringing his magnificent achievements to complete wreckage of "common sense" . . . as should be of great joy to Einstein . . . by declaring that no two minds ever have the same sensations, yet perceive them to be the same things by adding a "feeling of sameness" to them. And I remark, second, that in the field of physics, save in the possible instance of light undulations, science has never yet used any other conception of motion than that which requires the same thing to be translated from place to place . . . and though Maxwell warningly declared this to be perfectly unnecessary: psychology and physics have alike gone astray because of "common sense" paralysis.

After this preliminary elucidation, I may state concisely a main feature of the crisis in hand: Science is now doing all its practical work on the supposition of a plenum world of universally spatial content and translated motion. Philosophic opinion has overwhelmingly taught that no such world exists; that it and its motions are purely conceptual. But the latest determinations of experimental science make probable that the world supposed by physical science does exist in its full virtual entirety; but that it is not universally spatial, and that its motions are never but pseudo-motions such as the Undulatory Theory of Light and the warning of Maxwell ought to suggest: My task is to demonstrate this statement.

Evidences for Berkeley's Discovery

Practically all competent opinion both philosophic and scientific now affirms the Berkeleyan belief that all the things whatsoever of which the human mind is ever immediately conscious by means of any of its senses, are no parts of the spatial world which physics describes; but are mental things appearing in each individual mind at the moment of becoming conscious of them. A convincing appreciation of this fact is crucial to the crisis now inaugurating in physics; and must be grasped before considering whether the world be spatial or not. At the risk of becoming tedious, therefore, I must review in detail the evidences supporting this fact, by way of making sure that their bearing on the problem I am soon to demonstrate, shall not fail of full comprehension. Fortunately, however, these evidences also lead to those latest determinations that furnish a more consistent and profitable interpretation to the entire field of science. Therefore, without waste of effort we may now in an orderly manner and briefly gather up

these details that lead to new facts regarding motion and space, which no physicist or scientist can any longer afford to neglect. And I shall demonstrate them, before I close my thesis, expressed in precise mathematical equations that are in every way substitutable for the present working formulas of physics.

Look at the most distant star visible through the most powerful telescope! You are conscious of a tiny yellow spot . . . "right up there." But the star is not now up *there*. Its light has required thousands of years to reach your eye. The star, since its light now reaching you started from it, has circled through the distant heavens for centuries. Complicated astronomical calculations are required for determining its present direction from "the yellow spot." And it possibly may have perished by collision, and its cinders been spread through all regions of the compass. In short, the star may have ceased to exist long before any of us were born: Hardly, after Newton's discovery, can any colored spot be the star or planet that any physicist or astronomer presumes.

We follow the light from any object, to the eye. The lenses of no two eyes are precisely alike. They focus differently and give different mental "presentations" or visions. All are more or less stigmatic, making different eyes see things some longer and some broader than the average eye; and distorting all their shapes variously: Here is one reason why Berkeley and James declared that no two men ever have the same visions.

The light reaches the retina. Its pigments also vary for all men. In consequence, some men are color-blind; and the colors added to the shapes of which they are conscious, are in general more or less different among all mankind. Indeed, the vision of a few individuals has been discovered to be totally destitute of all colors save white and black, and their visual life to be wholly one of varying

shades of gray like those of an ordinary "movies show," or a photograph: These retinal pigments as well as eye-lenses prevent men from being conscious of the same tiny spot, or having the same visions of anything whatsoever.

The light stops at the retina. And some sort of disturbance runs thence through the optic nerve to the cortex. This nerve can be stimulated to such disturbance by other means than light; by concussion, pressure, various chemicals, and by electric currents . . . all of them producing crude color shapes or visions: But do we see the pressure, or the electric currents that so produce tiny colored spots in the mind?

All our other senses vary in individuals as strikingly as color. Most men hear the same tuningfork at a different pitch in one ear, than the other; and in both ears at once, different from when heard through either alone. Usually these mental sounds . . . and all sounds are mental things . . . are from a third to a fifth of a tone apart, and occasionally a full tone apart; as heard from the same fork: And something similar holds of all our senses compared in a multitude of individuals.

Just as light vibration must be distinguished from color, all our sensations must be distinguished from their physical causes. Not only the sounds of which the Italian girl makes us delightfully conscious by means of her vocal chords and her hurdy-gurdy strings, are no more the physical vibrations that cause them, than her charming face and gaudy dress are the hurdy-gurdy, but her odor of garlic must charitably be distinguished from her indispensable food. Most of our so-called tastes are smells got through the nose; the tongue has but a few real tastes; and we must distinguish both taste and smell from food, and its odor from the rose as much as color from light, and the tiny spot from the star. Our sensations of warmth and cold are stimulated by the pressure squeeze of different

tissues one of which expands and the other contracts at varying degrees of physical temperature. Temperature is not warmth or cold. Distinctions like the above hold through all our senses: Look around you again and realize that nothing in the world of your immediate consciousness is any part of the world physics presumes: So far, Berkeley and philosophy are indubitably right.

We now reach the cortex; the common field of all our senses. Ages ago, from *delirium tremens* and other abnormal conditions, the fact was familiar that men "see snakes" and experience every sensation as vivid as those of normal life when no physical thing exists normally correspondent to them. But the significance of this capacity of each mind to create a world of its own, was never suspected till the brain was discovered, and the workings of its cortex. But you, today, are familiar with the working postulate of all present medical and physiological science. . . . That the cortex is the instrument of all our conscious life. Also, after our review of the foregoing evidence, you should not be surprised in finding practically all present psychology agreeing that all the immediately conscious products of the cortex are constituents of the observer's mind.

In short, I may assume that you are now ready for those still more intimate details that lead to an understanding of the new facts I have promised. And, in approaching them, I beg you to recall, on the one hand, that the most active school of modern psychology, under the leadership of such men as James and Wundt, has adopted what, perhaps, in English is best called Sensationalism: the hypothesis that the entire mind or "stream of thought" is solely constituted of mental elements . . . though Wundt called them "will" elements . . . of the same general sort as the sensations "given," . . . to use a tentative technical word . . . by the human cortex. And to observe, on the other

hand, that only the most recent workers even in this school, have sufficiently freed themselves from the classic influence of rational philosophy, to consider if the "spatial world" of physics should be remodeled to the imperative requirements of their latest discoveries. In view of these discoveries and of what I have now said, I shall ask every physicist to realize that he should at least as carefully consider the instrument that reveals to him his "space" and "motion," as the astronomer considers a cobweb stretched across his telescope.

The Recent Discovery

The cortex is the top member of our nervous system. It is a wrinkled covering creased, from front to back, into two halves, and comprises a network of innumerable cells, billions upon billions, with sensory fibres running to them, and motor fibres running from them, throughout the body. If a woman's scalp were inverted, its skin would represent the cortex, and its long hairs represent the nerve fibres running to and from the body. There are many cells for each hair and vastly more fibres within the cortex, connecting its cells with each other, than there are fibres connecting them, to and from the body.

In the foetus, all the cells of the cortex grow from a common origin; but they develop to somewhat unlike capabilities, though these always are of one fundamental sort both as regards giving sensations to the mind and exciting the muscles. For our purpose we need not consider their control of the muscles. And as to sensations, we note first, that the cortex grows, in the foetus, to tolerably sharp areas that give, approximately, each its one qualitative class of sensation, and no other. By far the largest area is at the back of the head, and gives colors only. Just in front

of it is the area of sound. Then, low down on the side of the cortex, come, in turn, the areas of taste, and of smell. And above these, is the large middle area of mixed cells giving, each respectively, different sensations stimulated from the skin and internal parts of the body . . . our sensations of touch, heat, cold, muscle sensation, and perhaps, also, those of hunger, thirst, pain, and so on.

Not all the cells of any area give sensations at the same instant. And because of differences between our sense organs playing upon their respective cortical areas . . . those of the eye, ear, skin, tongue, nose, muscles, and so on . . . their cells give marvellously different results that are the key to the new discoveries I am to report.

As of highest importance regarding our entire nervous system, we note that no single cell of the cortex, ever gives to the mind a single sensation correspondent to the excitement of that single cell alone. A single sensation does not stand out separately in the mind, for each cell excited, at any given moment. From birth and till the rule be modified by unique circumstances I am to relate, all the cortical cells excited at the same instant, give the mind one undivided sensory product . . . one sensation without qualitative, numerical, or spatial parts.

This is typically exempled in smell. Gasses and vapors stimulate the nose membranes and the smell cells of the cortex, for the most part all, at once. Consequently we smell only one smell at a time; and can smell more only from such education as I will describe. Having broached this sort of fact, I bring to your consideration a Universal Law governing all our senses, by stating it dogmatically and demonstrating it, afterward.

Whenever, through life's experiences, single cortical cells or groups of cells have been more often or habitually excited simultaneously or "massively," than singly, in a series, they collectively give the mind a single "fused" sen-

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sation, when excited all together or "massively." When they have been excited more often serially than "massively," they give the mind, when they are excited "massively," a sensation or presentation in which the product of each cell or group of cells so habitually excited serially, stands out in the mind numerically separate. And when they have been excited more often in any fixed serial order, rather than otherwise, they give the mind, when excited "massively" or all together, a spatial sensation or presentation in which the product of each cell or group of cells, not only stands forth numerically separate, but occupies a place in the spatial result, corresponding to the place of that group, in the fixed serial order in which the total group has been most often excited.

This is, perhaps, the most important law ever discovered. It holds universally through all our senses and conscious life . . . as I will demonstrate by physiological evidence and laboratory experiments, and with particular elucidation of the evolution of number and mental space. And above all, bear in mind, it holds good for the entire world of physics. But already you should surmise that, if this law holds good, it must revolutionize all hitherto conceptions of number and space. No longer can they be regarded as unrelated, as science presumes, or the products of separate faculties, as Rationalists presume. They are products of one evolutionary law. Just how they revolutionize and enlarge all mental, physical, and biological science will be appreciated in due season.

I will now demonstrate our law throughout all our senses. It is an empirical law blundered upon by observation. Why it holds I can not guess. That it does hold good I will leave no room to doubt.

Smells are "fused wholes," though the cells giving them are innumerable; this, according to our law, is because gases and vapors excite most of the cells simultaneously.

A similar condition obtains in each muscle. Each muscle, in contracting, pinches most of its sensory fibres together, and muscle sensation generally is a fused whole, even when coming from several muscles at once. A similar condition also holds of the internal activities of the body, and the sensations we get from the stomach, bowels, lungs, blood circulation, congestion, inflammation, and so on, are of the type of fused sensations as smell. In the skin, the distribution of the specific nerves of heat and cold is approximately as numerous as those of touch; but temperature affects them all together, and our sensations of heat and cold are fused wholes and never are spatial. Food and drink affect the nerves of the mouth simultaneously, and tastes generally are fused. We have now seen six of our nine senses conform to our Law in the same type as smell.

The second subtype of our Law rises from any habitual preponderance of serial over "massive" stimulation, in no fixed order of series. This is most strikingly exampled in hearing. From an orchestra one hears a multitude of numerically distinguishable sounds, simultaneously. Why? The unique organ of the ear is the cochlea. It is composed of chords of different lengths, just as is an ordinary harp, or that of a piano. And each sound-wave of a particular frequency of vibration, reaches the tympanum, hits a particular string of the cochlea and sympathetically sets it in vibration, but none of its other strings. This excites filaments and cells belonging to that string, and sends a current to a particular group of cells in the hearing area of the cortex, thus habitually excited by the one sort of sound-wave; and from this group we always hear one tone. Different sound-waves, say from an orchestra, simultaneously excite each its one string and group of cortical cells; but through life, each string gets excited enormously more often alone, than in any particular combination with any

other strings; therefore, in accord with our Law, we hear several sounds at once.

Next we note why sounds do not weave to a spatial fabric like vision; and why sound typifies a middle stage of evolution, between sight and smell. While the strings of the cochlea are more often played upon singly than all at once, they are played upon in no fixed serial order such as our Law requires for spatial sensation. Note the fingers of a pianist! They skip over the keys in ever sort of serial order. And similarly, through life, sounds habitually come to the ear, in every sort of serial order. But if our hearing nerves could be hitched each to a single key of a piano-like keyboard, by playing on it in certain fixed orders of serial combinations, our hearing would be woven to spatial results in every way comparable to those of sight and touch. I hope to convince you of this, presently.

Next, as to sight. The eye is a globe that rotates, within limits, about its center in every direction. For each eye there is a normal axis of rest, from which such rotation begins and returns to. Overwhelmingly more often than otherwise, therefore, the rods and cones lying in any radius of the retina, get stimulated in a fixed serial order, during each rotation from, and in a reversal of that fixed order, in each return to that axis. Hence, in accord with our Law, the cortical cells of each retinal radius, give a line to the mind. Euclid conceived that no motion can pass from the first to third of successive points of a line, without passing through the intermediate point. Yet this is wholly a matter of genetic habit in our mental evolution, and can be changed.

Not only does the eye rotate in fixed lines, but when at rest, objects cross the fixed field of the retina overwhelmingly more often in continuous order, than they jump about from point to point of its field. Therefore the eye gets the same sort of fixed order of serial stimulation, both from

its rotation and from moving objects. And hence it is that the myriad retinal elements and the cortical cells corresponding to them, by predominant education, get knit up into line-giving habits in every possible mathematical combination of points into lines and of these lines into geometric shapes and figures. Only because of the incomparable multitude of the retinal elements, the delicacy of light stimulation, the perfection of the focalizations of the eye-lenses, the variety of colors that the sight-area of the cortex gives the mind, and the fixed order in which these cells get serially educated, does sight differ from our other senses and supremely consummate, both numerically and spatially, the Universal Law governing the genesis of all our senses alike.

There remains to examine touch, the most instructive of all our senses, regarding our Law. There is no part of our skin where the pressure of a pinhead does not cover many nerve-ends, yet give one fused sensation. Press the finest compass-points on this area, and they are felt as one. But spread the points, and a distance will be found at which the two points will be felt separately. This threshold distance for numerical twoness varies for every region of the skin; and varies with its vicissitudes of serial stimulation. Something similar holds for every numerical combination of pins, and for every spatial figure. Their respective threshold distances vary for every region of the body, proportionally to the stimuli that through life cross any region in a way to press its touch nerves serially rather than all together.

The entire skin has been mapped for innumerable individuals of all races. The numerical threshold or compass distance varies from four hundredths of an inch on the tip of the tongue, to three inches on the abdomen of those who wear protecting clothes. The tongue is forever rubbing the sharp corners and edges of the teeth; and this sort of

fine serial stimulation makes its tip our supreme organ of numerical touch perception. The ball of the forefinger comes next, for the reason that we use it preeminently for exploring fine points and edges; yet its threshold is double that of the tongue. The red of the lips is one-fourth as discriminating as the tongue. Half way up any finger, the discrimination is one-fifth that of the ball; and at the third joint is half that of the second joint, but still great because we are forever rubbing our fingers together and between things. Wherever the skin experiences fine serial motion, its numerical and spatial evolution is proportional to it and the radius of motion. This radius varies for the hand, arm and leg. The threshold is one-tenth of an inch at the finger tip; third joint, one inch; back of hand, one and a quarter; forearm, ankle and instep, two inches; back of neck, two and a half; upper arm, two and three-quarter inches; abdomen, three inches. All vary with serial experience and motion.

On any region where motion is more often horizontal than vertical, touch length varies accordingly. We rub the forehead sidewise, twice as often as up and down. Rock on it the edge of a card about an inch long, and it will seem twice as long horizontal as vertical. Explore the entire body, and every mental picture got from it will vary with life's experiences. By pressing on the skin various numbers of points set in rows and varying shapes, and edged dies of every figure and size, the entire surface of the body has been mapped by patient experimentation as well for number, space and motion, with this general result:

On every region there is a minimal area within which all sensation is fused, because serial stimulation of its nerves has been undeveloped. Widen from that area, and numerical distinction begins to creep in, though spatial pictures remain undeveloped. You perceive the number of points, but not their distances, nor their directions, one

from another. Spread the area, the points become numerically clearer, distances and directions begin to appear, then become clearer, and finally spatial mental pictures develop and so-called "motion" is observed in such touch-pictures.

The blind learn to read type in this genetic manner. At first they feel each type as a fused shapeless whole. Day after day they rock the finger over its points and sharp edges, serially; prominent points begin to appear numerically; then distances and directions unfold spatially; then edged shapes and motions; then the full clear shape of each letter. And the fact that type reading is thus genetic, suggested the following experimentation:

I have said that if our hearing nerves could be hitched to a keyboard and played on at will, space pictures would result, woven of sounds. Why, then, not prove our Law by artificial experimentation? The abdomen offered the best field because both from few serial motions and clothes protection, its number and space capabilities have been developed less than any other part of our skin. Also a machine could be constructed for artificially educating its nerve-ends in any serial order whatever.

The experiment succeeded. Conceive a subject blindfolded and stretched on a cot, his abdomen bare. Beside him a stand with a rotating arm bearing a box adjustable to the abdomen. The box was eighteen inches square and three inches deep. On the middle of its top was a keyboard of forty-nine cylinders arranged in a four-inch square, or in seven rows of seven cylinders each, their tops rising above the box, through holes. By pressing the cylinders, points were pressed on the skin, and springs lifted them when released. The points did no go straight down, but were attached to levers, concealed in the box, of varying lengths and running as promiscuously as possible through the area of the box; so that their points, when pressed, touched points of the abdomen, selected as helter-

skelter as possible over its entire area, and each cylinder or key always fixedly worked some one point of the skin.

The operator could work the square of keys in any order of combination whatever, either numerical or spatial. The spots on the skin were educated in the same order as the keys. But while the keys formed a four-inch square, the spots of skin were located helter-skelter over the whole abdomen, and their spatial arrangement could have nothing whatever to do with the results obtained.

The course of education was made to conform to what the Law would genetically require. First, the pairs of points that gave one sensation were taught to give two; then threes to give three; fours to give four, and so on. Next, by pressing one after the other the keys of a side line of the keyboard, their skin points were slowly educated to give a line. Then, other lines and figures were evolved. Distance and direction evolved only after lines of different numbers of components were evolved and compared innumerable times. Edges were rocked over the keys to stimulate them serially in straight lines, circles and various figures. Then edges were used to press the keys in these lines and shapes, in order to teach their skin-spots to give corresponding lines and shapes, by simultaneous pressure. Every numerical and spatial combination possible to the machine was taught to each subject. Every subject was controlled as to suggestion. At most they were told the purpose was to educate them as a blind person is taught to read his page of type. They never suspected the levers concealed in the box, pressed spots helter-skelter in the skin. The required period of education was long; therefore the number of subjects was necessarily few for the one laboratory. But all of them demonstrated the Law, proportionally to their education. One subject persevered four years, and at the end of that time his touch pictures got from the promiscuous spots were nearly as clear and

accurate, both numerically and spatially, as those got by the eye. Show him a diagram of the keys, and he would tick off on it instantly the series of keys, or the figure pressed, and with no more errors than when doing likewise after seeing with the eyes.

Our Universal Law warns us that physical things need not be square in order to be felt or seen square. The skin-spots and cortical cells that give a mental square, do not necessarily themselves form a square. All our cortical cells lie with no regularity in its crumpled folds. When we look at Bunker Hill Monument, the cells giving the mental vision do not themselves form a model of that historic structure. Those giving a line or a square do not lie in a line or a square. Whatever geometric form they do give depends on their most habitual order of serial stimulation. Our numerical and spatial perceptions evolve as habits. And we use the same general habits for seeing spots of skin, tiny yellow spots in the starry heavens, and the physicist's entire world of material things.[1]

Just here we must be careful! The order of stimulation that rains in on our cortical cells may be what it is, just because the world is spatial. Nothing I have yet said of itself proves that the world is not spatial. And we must go further.

Nevertheless, we have learned a profound and startling lesson! The stars need not be themselves spatial, or be arranged in a spatial world in order to make us conscious of such spatial sky-visions as we get from the heavens and its movements. And the same holds good of all physical things and motions. Also we have learned that at least mental number and space can be artificially manufactured to order, within the limits of laboratory experimentation, and that, normally, number, space and all our senses evolve

[1] For the first publication of this Law and the experiments in which it was discovered, see my book, *Our Notions of Number and Space*. Ginn & Co., Boston, 1895.

by one Universal Law. If science had been free of traditional opinion, comparative biology and physiology should have made men suspect that cortical cells having a common origin from the same germ, should have evolved sensory functions by some common law such as we have discovered. And one should now weigh the bulk and character of the evidence I have furnished. Hardly can it be an accident that all the notably different and, some of them, marvellously complex sense organs that mediate our nine different senses, should all be precisely such as to furnish their respective cortical areas precisely the order of habitual stimulation required by a law discovered from purely empirical investigation.

The Universal Law stands without the artificial experiment on the abdomen, that proves it. I do not see how any reflective mind can resist the physiological and psychological evidence for it; or that rising from the classic philosophic bemuddlements that it clears up. And the story is yet only half told. For we have still to see it unfold in our problem of a spatial world and in physics.

Mental Quantity

Two matters must be now recalled, by way of making our further course the more swiftly understood. These are the Sensationalism and the Mental Genesis adopted by the followers of James and Wundt. The mind is solely constituted of mind-stuff like that given by the cortex. All our mental processes evolve from its "first hand" sensations. From sensations evolve thought images. Sensations are stimulated by the sense-organs. The same cortical cells that thence give sensations, later, when stimulated from within the cortex by its associational processes, give thought images or faint and fleeting copies of the sensa-

tions from which they so derive. Memory and all our rational processes are comprised of such thought images; or rather, of sensations and thought images combined.

The entire mind, all its faculties, genetically evolve from sensations, and these sensations evolve by our Universal Law. Moreover, Sensationalism declares the entire universe to be comprised solely of mind-stuff of the same general sort as that of our minds; and to have evolved to its present condition, inclusively of our minds, by one and the same set of genetic laws.

What sorts of crudely evolved minds constitute the present world and vast heavens, we will consider when prepared to do so. But because physics is above all *quantitative,* we must now study the evolution of numerical and spatial quantities, by our Universal Law.

For this, let us first note that the mind's "stream of thought" is not a stream; but is a "movies show," whose past always has ceased to exist, and whose future does not yet exist. It is absolutely transformative, and each momentarily existing state as a whole, transforms into the next state as a whole. In short, our Universal Law of Genesis is one of *origins;* but these origins cease to exist absolutely, as far as each existing state of the mind is concerned, and save in so far as corresponding habits are stored in our nervous systems, and the course of our minds follow certain corresponding laws.

And, finally, let us recall, preparatively of the details of our problem of quantities, that when any fused non-spatial sensation primitively evolves by our Law, to a line, that line expresses and measures the *potential* quantity of that non-spatial origin. With this in mind, let us turn to the "crudely voluminous" sensations of James and Ward.

These authors suggested our problem of the genetic origin of all spatial quantities from "crudely voluminous" sensations. Are fused smells in any way quantitative? Do

quantitative lines and figures evolve from sense elements that are not spatial? I will dogmatically sketch my answers. Energy is measurable solely in its effects. The energy of gunpowder is measured by the distance the cannonball goes. Physics can only declare that its energy is potentially capable of quantitative results. And our Law claims only that fused sensations *evolve* to sensations whose parts can be counted and to lines and geometric shapes that can be measured. I will formulate the very simple law:

Every sensation, fused or otherwise, from which any numerical sensation derives, is potentially counted in the numerical sensation or sensations that derive from it. And every non-spatial sensation from which any spatial sensation derives, is potentially quantitative, and is measured in the geometric sensation derived from it.

Conservation of Matter and Energy, and the New Physics

We have next to consider the bearing of our Genetic Law on the Conservation of Matter and Energy. In this discussion, I am brutally outlining matters each of which demands exhaustive consideration. Two such are involved in this "Conservation" problem. Physics has supposed ions or atoms that have preserved their identities for untold ages. Clifford and James in their "mind stuff theories" of the universe, fell victims of this tradition. They conceived their sensation elements to be indestructible; and to go from mind to mind, eternally. Also to be unconscious things, save when "added" into some mind, by some mysterious "act of conscious addition."

But each mind is a transforming movies-show, whose existing state is always a conscious whole. Every sense-

element is consciously in some mind however crudely evolved. Every mind of those to which Sensationalism reduces the universe, is a conscious whole . . . even the most "vacuous minds" of the interstellar spaces that may prove to be as simple qualitatively and only as potentially quantitative as a fused smell.

But granting all this, how is conservation to be preserved? Plainly not in each momentary transformation of one mind. You awake from sleep. Your first sensation may be a single fused whole got from your muscles cramped in bed. You open your eyes, and instantly this muscle sensation transforms to a spatial vision of your room. And though by our Law each point, line and geometric figure of this vision derives from fused origins which together potentially account for their quantities and transform from somewhere, yet the potential quantity of your first awakened muscle sensation does not account for the genesis of these geometric quantities of your vision. Each momentarily existing state of the mind as a whole, transforms to the next whole state of your mind. And these succeeding states are as quantitatively unlike as a tiny yellow spot is smaller than a sudden vision of the heavens, or a wide landscape vision got from opening the eyes. How, then, with such enormously unequal quantitative transformations forever occurring in each individual mind, is conservation to be preserved throughout the mental universe presumed by Sensationalism to replace the spatial world of physics?

Our Law forbids mental elements to go from mind to mind. But when any sensation either potentially or actually quantitative like a geometric figure, disappears from one mind, there is nothing in the Law forbidding an equal quantity to appear *compensatingly* in some other mind or minds; or against such compensations being governed by a law of quantitative conservation, throughout the Uni-

verse. And if so, may not the unequal transformations of individual minds . . . exampled in the muscle sensation transforming to a vision of your room . . . be thus lawfully compensated in the other minds of which Sensationalism constitutes the universe?

This brings us to modern evidence that "multiple personalities" dwell in each human body. Sometimes five or six of them demonstrate their separate individualities, traits and temperaments; not to mention those unable to control the muscles for so demonstrating their existence. French hospitals and clinics have settled this much scientifically. And the probability is now overwhelming, from facts we are further to consider, that every highly evolved nervous system is split up into several minds, some of them simple and some complex like *the* human mind. But, for the moment, let us only entertain the general notion of Sensationalism that the entire universe is comprised of minds now in various stages of evolution, and let us see what such an Universal Law of Quantitative Compensation as I have intimated, would furnish for our Problem of Conservation!

First, let us see how it could be made to satisfy present physics! And let us presume ions, atoms, mass and inertia to be formulated in terms of motion as physics now inclines to do. Its "universal fluid" so becomes a mutably moving space void of all other character save geometry and motion. Do you believe possible that the world of biologic evolution can be one of pure space only? We shall find reasons why it can not. Moreover, for our purpose, let us conceive this space to be comprised as are our mental visions, of transforming colors.

Should the universe be comprised of sense elements, we should expect in it innumerable classes of them beside those of our nine human senses. But to make our task easier, let us for the moment use "color" to express sense

quality of mind-stuff in general. And so doing, let us conceive the mutable space of future physics to be of one tint of color throughout, when in perfect rest, and each point to transform to some other tint or color, by some universal law, proportionally as it moves. The Helmholtz vortex-ions, or the ions of present physics are its ultimate particles of matter, and under our "color scheme," these now become colored proportionally to their motion, both internal and by bodily translation. And all the ether motions of light, electricity, and so on, become varying color-streaks, much like those Roland conceived the light-rays to be. But with this difference. . . . The colors *are* the ether; constitute its energy and motion. Moreover the ions and chemical atoms become each a different color proportional to its atomic weight or mass interpreted as motion, as physics now inclines to do.

Also, whatever energy means, as reduced to motion, it becomes, whether "stored" or "kinetic," an ever varying tint of this more permanent color of the various chemical atoms and material bodies generally. And as well, all distributions of energy, both in the ether and among material bodies, become such superadded tints. And finally, if we conceive all these transformations to be of the same sort as we have discovered for our sense-elements and "whole" mind, the universal fluid of present physics becomes of identical sort with our own mental color visions from which we mainly get our knowledge of material things. And most significantly for physics, all motion becomes pseudo-motion such as the Undulatory Theory suggests, Maxwell virtually predicted, and is alone displayed in our mental visions from which we mainly get our notion of physical motion of any part or thing of the universe.

In short, this mental, "colored," pseudo-moving, spatial world becomes a perfectly working substitute for the present world of physics . . . as I will now demonstrate.

Every physicist is familiar with the assumption that the motion or energy concerned in the propagation of light, dissipates from each successive point, in every direction of a sphere and inversely to the square of the distance of the propagation. Conceive, then, the "color" that in our new physics is to replace the universal fluid and energy and motion of present physics, to be dissipated by a precisely similar law. It is precisely such a sort of substitutive conception as Maxwell recognized to be possible. But how can it be reduced to mathematical formulation?

The Law of Dissipation by Transformation

The answer is amazingly simple. Quantitative dissipation of energy or motion is realized and measured only in its results. The "color" we are substituting for it is realized and measured in the same way. The varieties of "color" or sensation in the Sensationalist's world are innumerable, no doubt, and we don't yet know what any of them are, comparatively with our own; nor do we need to know for our purpose in hand, more than we need to know what energy is like to the eye.

Conceive the base or zero of the axis of a reference frame, as Einstein would call it, to be of a color representing absolute rest through our "color universe," and all its possible "colors" or sense-qualities to be continuously scaled along its axis. Already we have conceived every point of matter and ether to be colored theoretically in proportion to its stored energy or motion. Conceive, now, this stored color of each point to be transformatively dissipated, in every dynamic process involving that point, in accord with essentially the same law as that of light-dissipation, and in accord with the further law that here follows:

Whenever the color of any point transforms to any other color, representatively of any loss or gain by reason of dissipation or any other change of energy or motion, it shall be conceived to change successively through all the colors registered on the scaled axis, from the color registering the color of the point before the dissipation or motion began, to that registering its color at the end of the dissipation or motion.

The color of any point of ether or matter, as registered at any moment on the scaled axis and as measured from zero on that scale, will now represent the condition of mass and stored energy of that point, at that moment; afterward, any change of color representative of dissipation or motion involving that point, when similarly registered, and measured up or down the scale accordingly as the change represents loss or gain of energy or motion, will mathematically measure that loss or gain, and the new registration will represent the new condition of mass and energy at the end of any dissipation or motion.

With this law we are now able to frame mathematical formulas and equations for our "colored" world of physics, in every way perfectly substitutable for those now used, and as perfectly workable for every purpose either of experimental or theoretical physics.

In the *Introduction* volume (printed in 1904) of my otherwise unpublished, eight-volumed *Treatise on Cosmology,* I give all the elementary formulas commonly found in textbooks of physics, worked out with mathematical precision in accord with the substitutive mental world I have now sketched; all perfectly ready for practical use in every domain of present science . . . and as well for the enlarged horizons that I shall presently sketch for all science and mankind. And I hope by this address to stimulate a more understanding interest in them than that *Introduction,* mainly historical, permitted . . . or at best, achieved.

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With these formulas you are familiar: $t = \frac{l}{s}$, $l = st$, $a = st$, $\phi = ma$, $\phi = \frac{ml}{s}$, etc. I will illustrate the substitute conceptions, by simplest examples. When any body or point moves, its mass-energy or as I now say color, and as well that of every other point and thing of the universe, transforms in accord with our Law of Dissipation by transformation. The mass-energy or color of the moving body or point is at every moment computable from the parallelogram of forces of the entire universe; precisely as now for gravitation. The motion is not one of literal translation. It is transformative or pseudo motion essentially like that of the "distribution" of light undulation. If the same mass-color appear in each successive point of any path of such motion, this is what has always been called "bodily translation," and is due to a like mass-color being caused by transformative universal dissipation, in each successive point of the path. The distance traversed is the length or l of ordinary physics, and time is the same t; while speed, still expressed by s, becomes the rate of color change required for maintaining the mass-color involved; hence, $l = st$ as heretofore.

Mass is the "color" stored in any body, as permanently as mass shall prove to be permanent, and the m of present physics measures the scale-distance of that "color," from norme, on the color-axis. Mass, theoretically, is the "color" of a body in a vacuum, at rest, and free of strain; while energy and force are additions or accelerations of mass-color, due to dissipation or motion. Hence, as of old, $\phi = ma = \frac{mt}{s}$. *And so on through every mathematical formula of present physics.*

So much for the spatial world of present physics interpreted in mental equivalents such as the exact determinations of mental science now afford and require. And we have next to consider why and how this revised spatial

world is to be further revised to a non-spatial world as mathematically workable as the one I have just sketched, and to such a universe as offers an enormously more profitable and enlarged horizon to all science, satisfies classic philosophy, and adds a new scope to mankind by uniting all science, philosophy and effort, to a profounder interpretation of life and an inspiring religion of its possibilities on earth and hereafter.

Present "Parallelism" Improbable

Preparatory to our final revision, we return to the Conservation of Matter and Energy. I signified how this is to be preserved by compensating transformations among the multiple personalities or minds which Sensationalism now regards as comprising our nervous system and the universe, as well. But how with mathematical precision extend this to the entire universe that is the goal of Sensationalism? You are familiar with the present working hypothesis of Parallelism. The human mind is supposed to "parallel" the activities of the human cortex and body. Similarly every animal body is supposed to be paralleled by its mind, down through the scale of biologic evolution to the simplest animalcules. But at bulk protoplasm, such as that from which all living bodies evolve, Parallelism halts, and refuses to credit mentality of any sort to it, or paralleling any part of the physical world of lifeless matter. Its philosophers, like William James, conceive consciousness to be something that "comes in" to biologic evolution at a definite point; and all the prior, "quasi chaos" mind-stuff conditions from which they derive conscious minds, they conceive to be unconscious things and processes having no parallels in the world of physics.

But why do you presume your nearest friend, your wife if you have one, to have a mind? You never see it, or are immediately conscious of it, by means of any of our senses. You only infer its existence, and only from what happens in your own mind. Because the naive man's mind displays a certain set of visions that he mistakes for his body, and another set that he mistakes for his wife's body, he infers a mind for the latter, as the analogue of his own. Because of our sensations got from animals generally, we infer and only infer minds for all animals . . . down to animalcules. But since all our visions and sensations evolve by one common derivation, and all our mental faculties evolve in one indivisible process of growth, by what consistency of "common sense" do we use them to infer minds for animalcules and not conscious mentality for protoplasms and for the entire universe?

From native instinct, without philosophy, men and animals have always inferred the existence of something other than their own minds for every sensation of it. They could not get their food or live, otherwise. No instinct is more indispensible. None is more authoritatively to be trusted, till something other than "Rational" Philosophy concocted from Scholastic Logic shall disprove it. And once awake to a mental universe, this authority from before Reason was born, bids us to infer mental things corresponding to all our sensations, precisely as all unsophisticated men heretofore have inferred material things, in our surrounding world.

In short, recognizing that we knit and weave together all our spatial sensations and memory images of them to form our Conception of One Universal Space and World of Spatial Things, mental genesis, consistency and common sense demand that we fill out this conception for every item of our senses, and if we "parallel" any of them, parallel them all. But we must not parallel them doubly; once

to give us the world of present physics, and again to give us the mental world of Sensationalism. Common sense and Occam's Razor forbid it . . . and the more peremptorily because physics no longer needs a double world. Therefore let us strive to master the one non-spatial world that our foregoing discussions require!

Conception of Non-Spatial World

Every man's total Conception of a Spatial World is woven from his spatial sensations of sight and touch, and every individual pattern of them has its particular place in that total conception, into which it may be fitted. But no man has seen the earth's entire surface, nor its interior bulk, nor that of the planets, nor every point of the physicist's three-dimensional world. Therefore, there are vast holes, as it were, in every man's total conception of universal space, for which no actual sensations of his mental life have supplied a quantitative counterpart. And therefore the "actually filled" parts of his total Conception would not quantitatively supply the demands of the conservation of matter and energy, as interpreted by our law of compensating quantities. Consequently, let us start more systematically from the primordial state of the total universe which Genetic Sensationalism may theoretically presume.

Genetic Sensationalism does not yet know enough about primordial minds, to venture a definite schedule as to what was the first state of its mental universe, or to describe how that first state evolved, through untold ages, to its present constitution of innumerable minds, most of them yet unfathomably more simple than our human minds. In its first infancy, Sensationalism waits, for that schedule, till it discovers more about Comparative Mental Genesis.

But for theoretical purposes, it may conceive the first state of the world's evolution to have been one vast, fused sensation constituting one absolutely single mind . . . rather than one vast nebula, as the physicist now presumes, and to have evolved from that to its present condition, by ways I have brutally intimated and will make clearer. And theoretically . . . mind I say theoretically and for expounding a general idea . . . sensationalism may conceive that the destiny of the quantitative evolution of all the parts of the universe that have not now evolved from fused sensation to numerical sensation and thence to spatial sensation, should complete that evolution under our Universal Law, in some theoretical hereafter . . . and all the mind stuff of the original "one sensation" be so converted into one vast, "colored," mentally spatial universe such as I described to replace, tentatively, the present universe of physics. With no scrap of mind-stuff left out of such completed evolution, the final one spatially evolved whole would have no "holes" in it to puzzle the physicist as to how Sensationalism is to be made quantitatively workable and satisfy the problem of Conservation. This is not a conception entertained for the actual evolution of the universe, but is one rightly entertained theoretically for understanding how the "holes" are quantitatively and measurably to be filled up potentially, in our working hypothesis of a mental universe not universally spatial.

Let this much but illumine the facts that if a single, fused, non-spatial and only potentially quantitative, primordial sensation *did* evolve in accord with our Universal Law and in ways I have indicated for the human mind, the conservation of matter and motion would be perfectly preserved at every stage and moment of such evolution. Whereupon, we have reached a point requiring careful distinction between the immediate problem of converting the spatial world of present physics into a non-spatial world,

and the future problems that will enlarge all the horizons of science and mankind, as the result of a unified conception of all the sciences physical and mental, and of the universe.

For the immediate problem, the physicist does not have to know the constitution of the simply evolved minds with which Sensationalism replaces his present world; or the mental details of the inter-planetary spaces and starry heavens. He needs only to know how his present world can be mathematically and workably formulated in terms of mind-stuff rather than of his universal fluid. He does not need to know what "multiple personalities" or single minds his universal fluid shall split to, or where their boundaries shall run. If what I have indicated regarding the potential quantities of non-spatial sensations, and regarding the transformative compensation of all quantities, between minds, holds good, universal conservation will be preserved regardless of what minds they be, throughout the universe, between which it be so preserved.

For the present and for any such problems as he has heretofore entertained, the physicist need only to replace his universal fluid with the spatial "color world" that I have mathematically formulated in a way essentially preserving every present formula of physics. And, because, for the larger problem, anything crucial to it that I have not said, may best find place in an orderly summing up of this paper, let us proceed to that task.

Summary

The epoch of Berkeley divided the world of knowledge into two hemispheres, both hostile to their mutual development and profit. Philosophy and Religion went one way, Science another. This divorced their common offices, interests, efforts and results . . . and their good feelings.

For three hundred years, philosophy evolved toward present Rationalism and came to complete dominance of professional authority over psychology and the metaphysics of science. Mental science, so dominated, made worse than no advance from the naive "faculties" of Aristotle and the sophisticated "logic" of the Middle Ages. Science, on the one hand, became nauseated of such "meatless" speculations, and on the other hand, became so proud of its own magnificent achievements, and so convinced that nothing better was possible, as to neglect to overhaul the fundamentals on which it had built and had inherited from the most primitive speculations of mankind. And to this day, or to the advent of the disquieting Einstein, physics has persisted in this attitude . . . vitiated, cramped and stultified of anything better.

Meanwhile, almost in the lifetime of some of us, psychology took a new life. The brain was discovered. Darwin came; biologic evolution; then mental evolution. Soon its leaders evolved Sensationalism of the schools of James and Wundt; but still under the contamination of Rational Scholasticism. Then their followers developed the more consistent Sensationalism I have unfolded.

The main points scored by it are these:

The new psychology requires to "parallel" all material bodies, with some sort of conscious mentality, as well as

animal bodies . . . not to stop at protoplasm. But this would give us two universes; the present universe of physics, and a full mental counterpart of it. And we need but one; and two are improbable.

The latest developments of Sensationalism make possible to formulate, with mathematical accuracy, a mental world not universally spatial, but in every way workably and theoretically substitutable for the spatial world of present physics.

Our Universal Law of evolution of fused sensations to numerical sensations and thence to spatial sensations, reveals how sensations only potentially quantitative evolve to lines and geometric figures that measure them, and themselves can be measured. Also our Law of Transformative Compensation reveals how Conservation of matter and energy is preserved throughout the universe.

The immediate conversion of present physics to a mental physics perfectly as workable as the old but with enlarged horizon, requires only such a substitution of pseudo-moving "color" for ether and matter and energy as I have mathematically formulated.

There remains to view the future. I can not in this one discussion indicate, in detail, what must happen when physical science shall be enlarged to universal significance, through being multiplied by the Universal Laws now discovered and reported for your consideration, and when all that hitherto has been known by man be multiplied by what shall so be revealed to him.

Daring, and indeed compelled by your expectations, I venture two feeble prophecies . . . probably unlike what will happen and inferior to it. When scientific interest is sufficiently turned to it, physiological chemistry will determine what varying physical and chemical conditions in the cortical areas, cells and activities respectively giving our different senses, correspond to these differences, and these

discoveries will give the key for identifying the actual "colors" or sensation-elements with which the new physics is to replace the atomic and ether motions of present physics. Also because the analogy between electricity and nervous action regarded as mental action is so growing, not only will the problem of why and how the human nervous system splits up into "multiple personalities" or minds be solved, but that of how the entire universe of Sensationalism splits up into innumerable minds of yet unimaginable varieties, some wonderfully more simple and some "godlier" than our own.

And with these keys to the new physics so indicated, and all knowledge united, I dare to suggest that, as the expert now points his telescope-spectroscope to the most distant stars and discovers with precision the chemical constitution of them, so similarly, may not be impossible, shall his successor point his mental spectroscope to the planet Mars and discover the sort of minds who inhabit there . . . or his accumulated knowledge discover the simple minds of the atoms, or the superhuman minds that Fechner and James in no unsober flight of imagination attributed to distant planets of the heavens. Once start the new science and their is no end to its possibilities.

So much of the Crisis as involves science alone, I frame in this question: Will the two hemispheres of physical and mental science plod on in hostile contempt of each other, or will they awake and unite to the common welfare that now unfolds to them?

But by no means is this the total crisis. For centuries, mankind has brutally blundered upward under the blind impulses of instinct, and only crudely maintained in stability by the rule of the strong. In their boundless ignorance the world's masses have suddenly awakened to boundless resentment, boundless innovation, boundless self-confidence and to boundless will.

In a time of economic and moral wreckage fevered with the residuary legacies of war, the entire world . . . the unlettered and the lettered alike . . . are afire with the spirit of wholesale revolution: With the frenzied hallucination of the untried. Shall scientists guide this revolution . . . or let it fizzle in the deliriums of the ignorant?

Before the great war wrought this delirium to frenzy, the masses had come dumbly to trust science for their salvation. But they have outrun all patience . . . and Einstein has advertised to the whole world that "common sense" science no longer has trustworthy reputation. Behold how great a chaos a little spark may kindle at the present moment! All mankind is at a crisis. And all careful thinkers are worried, the world over, as to what is about to happen.

The foundations of science are not yet sound . . . for its own purposes, or for securing a better insight of morality in life, economics, government, civilization and religion.

Yet the horizon is ready for clearing. And it is up to every individual scientist to take interest; no longer demanding everyone to take interest in his own work while neglecting to inform himself of the foundations of all knowledge.

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"FORM" AND "SIMPLE NATURE" IN BACON'S PHILOSOPHY

CONSIDER any sense-object, e. g., a live coal. This coal has certain what have been termed subjective, phenomenal, secondary qualities. Thus it has color and heat. It has also primary, what may be called essential, qualities. To heat, for example, corresponds a mode of motion of physical particles, which mode of motion is considered as at least partially[1] causing heat. In Bacon's words, it is the "form" of the "simple nature," heat.[2] "The thing differs from the form no otherwise than as the apparent differs from the real, or the external from the internal, or the thing in reference to man from the thing in reference to the universe." [3] Such is form and such is simple nature, and each implies the other. "For when I speak of Forms, I mean nothing more than those laws and determinations of absolute actuality, which govern and constitute any simple nature . . ." [4]

Bacon believed it to be possible to define simple natures both accurately and exhaustively. "I propose to treat then . . . sixthly, of the Limits of Investigation, or a Synopsis

[1] Heat implies the existence of a certain relationship between subject and object. Thus, the (objective) mode of motion of physical particles associated with heat may exist without the existence of the mentioned relationship; with, therefore, no implication of heat .

[2] See *Nov. Org.* II, 20.

[3] *Nov. Org.* II, 13.

[4] *Ibid* II, 17. Cf. *De Aug. Sc.* III, 4, p. 469 of J. M. Robertson's edition, *The Philosophical Works of Francis Bacon, reprinted from the texts, etc., of Ellis and Spedding,* 1905.

of all natures in the Universe." [5] Simple natures are the alphabet of the phenomenal universe. Just as a limited number of letters go to make up an infinite variety of words, so simple natures go to make up the infinite variety of natural phenomena.[6] Every sense-object so far as phenomenal is reducible to a combination of certain of these simple natures. In gold, for example, the following simple natures meet. It is yellow in color, heavy up to a certain weight, etc., observation determining what simple natures meet in any concrete body.[7] The question arises—what principles of corpuscular structure, i. e., what forms, correspond to these simple natures? If this were known, we could produce simple natures; we might even join together in one body all the simple natures manifested in gold; that is, we might even make gold.[8] Bacon did not despair of attaching to simple natures their respective forms, to which end, indeed, he devised his method of exclusions. Let X represent a simple nature. The problem is to discover its form. Simple natures are supposed distinct in kind from one another. The form of X does not, therefore, lie amid the remaining simple natures. Bacon argues in this wise—such and such a principle of corpuscular structure is present where no X is, is absent where X is, varies without a corresponding variation of X, therefore that principle of corpuscular structure is not the form of X. So with other principles of corpuscular structure. But these are limited in number. Ultimately, all of them are excluded save one, which remains as the form of X.[9]

Notwithstanding Mill's opposition to Bacon in connection with plurality of causes,[10] it is quite correct to attach, as the latter does, *one* form to each simple nature. Con-

[5] *Nov. Org. II*, 21.

[6] See *De Aug. Sc.* III, 4, p. 469 of J. M. Robertson's edition (already cited) of Bacon's philosophical works.

[7] See *Nov. Org.* II, 5.

[8] See *Nov. Org.* II, 5.

[9] See *Nov. Org. II*, 16.

[10] See J. S. Mill, *A System of Logic*, ninth ed., bk. V, chap. 3, para. 7.

sider the case of the simple nature, heat. No doubt, there are many *efficient* causes of heat, but heat being heat (its nature clearly defined) and cause operating in effect, they must have some factor or factors in common. This or these factors, principles of corpuscular structure, are form. "Now if a man's knowledge be confined to the efficient and material causes (which are unstable causes, and merely *vehicles, or causes which convey the form in certain cases*) he may arrive at new discoveries in reference to substances in some degree similar to one another, and selected beforehand; but he does not touch the deeper boundaries of things. But whosoever is acquainted with Forms, embraces the unity of nature in *substances the most unlike.*" [11] "For when I speak of Forms, I mean nothing more than those laws and determinations of absolute actuality, which govern and constitute any simple nature, as heat, light, weight in every kind of matter and subject that is susceptible of them . . . But if any one conceive that my Forms too are of a somewhat abstract nature, because they mix and combine things heterogeneous (for the heat of heavenly bodies and the heat of fire seem to be very heterogeneous . . . and yet they agree . . . in the nature of heat . . .); if any one, I say, be of this opinion, he may be assured that his mind is held in captivity by custom, by the gross appearance of things, and by men's opinions. For it is most certain that these things, however heterogeneous and alien from each other, agree in the Form or Law which governs heat . . ."[12]

The distinctions above drawn between form and simple nature Bacon does not always accurately observe. Thus he frequently speaks of his method of exclusions as proceeding by exclusion of *simple natures,* whereas, strictly, as we have shown,[13] it must be considered as proceeding by exclu-

[11] *Nov. Org.* II, 3. Italics mine.
[12] *Nov. Org.* II, 17. Cf. *ibid.* II, 23; *De Aug. Sc.* III, 4, p. 470 (top) of J. M. Robertson's edition (already cited) of Bacon's philosophical works.
[13] See *Supra,* pp. 2-3.

sion of *forms*. "For exclusion is evidently the rejection of simple natures." [14] "We must make therefore a complete solution and separation of nature, not indeed by fire, but by the mind, which is a kind of divine fire. The first work therefore of true induction (as far as regards the discovery of Forms) is the rejection or exclusion of the several *natures* which are not found in some instance where the given nature is present. . . . Then indeed after the rejection and exclusion has been duly made, there will remain at the bottom, all light opinions vanishing into smoke, a *Form* affirmative, solid and true and well defined." [15] Why should Bacon here use the ambiguous word, "natures," when his method of exclusions must, as we have shown,[16] be considered to proceed by exclusion of forms and not of simple natures? The same ambiguity occurs in *Nov. Org.* II, 18, "I must now give an example of the Exclusion or Rejection of *natures* which by the Tables of Presentation are found not to belong to the Form of Heat." (Italics mine.) "The work and office of these three tables I call the Presentation of Instances to the Understanding. Which presentation having been made, Induction itself must be set at work; for the problem is, upon a review of the instances, all and each, to find such a *nature* as is always present or absent with the given nature, and always increases and decreases with it; and which is, as I have said, a particular case of a more general nature." [17] The "given nature" is a simple nature, viz., heat. The nature which is always present or absent with the given nature, and always increases and decreases with it, must be considered to be the *form* of heat.

The distinction drawn by Bacon himself between form and simple nature being vague, it is not surprising to find

[14] *Nov. Org. II*, 19.
[15] *Nov. Org.* II, 16. Italics mine.
[16] See *supra*, pp. 2-3.
[17] *Nov. Org.* II, 15. Italics mine.

a similar vagueness in Bacon's expositors. "For assuming that each instance in which the given nature is presented to us can be resolved into (and mentally replaced by) a congeries of elementary natures, and that this analysis is not merely subjective or logical, but deals, so to speak, with the very essence of its subject matter, it follows that to determine the *form nature* among the aggregate of *simple natures* which we thus obtain, nothing more is requisite than the rejection of all foreign and unessential elements." [18] Forms are the concomitant of simple natures but are not simple natures; are not, therefore, to be found among the aggregate of simple natures. "We reject every *nature* which is not present in every affirmative instance. . . ." [19] "Again, this method of exclusion requires only an attentive consideration of each 'instantia,' in order first to analyze it into its simple natures, and secondly to see which of the *latter* are to be excluded." [20] And there are other passages. Some of Fowler's criticisms, too, would appear to be inapt. "New, perhaps, the first remark that occurs to one in considering this method is that it seems to be assumed that every 'simple nature' has some other *'simple nature"* which is its form, or part of its form. Thus, heat, which is itself a simple nature, is a species of motion, or, to put the same thing in different words, an effect of motion. Some of the *'simple natures,'* then, are genera or causes of the other simple natures. But, if so, there must evidently be some one or more of the *'simple natures'* which cannot be brought under any genus or cause. This or these, then, have no 'form'." [21] *Forms* are 'genera or causes' of simple natures but are not simple natures. Consider, also, this passage, "There must be some one, if not more, of the 'simple natures' which is ultimate, and therefore

[18] J. M. Robertson's edition (already cited) of Bacon's philosophical works, pp. 20f.-21. Italics mine.
[19] *Ibid.*, p. 21. Italics mine.
[20] *Ibid.*, p. 21. Italics mine.
[21] *Nov. Org.*, ed. by T. Fowler, 1878, p. 61. Italics mine.

has no 'Form' outside of itself. To this objection, however, Bacon would probably have replied that the ultimate character of such a 'nature' would be ascertained by a due use of his method; for, if all the other 'simple natures' were excluded, it would follow that there was no external 'Form' or cause of the nature in question." [22] No simple nature would appear to be ultimate, as to each, we have shown above, corresponds a form. Fowler fails to distinguish between form and simple nature; indeed, he includes the former under the latter. Moreover, it is incorrect to state that the ultimate character of what Fowler calls any ultimate simple nature would be ascertained by the exclusion of all other simple natures (simple natures including simple natures proper, and forms, according to Fowler). By an "ultimate simple nature" is meant what ought, strictly, to be termed form. But the ascertainment of form does not imply the "exclusion of all other simple natures" either in the meaning attached to simple nature by Fowler or in its meaning proper. Forms and simple natures (in the narrower sense of the latter) correspond to one another. Where a form is, therefore, there also will be a simple nature.

Bacon seldom fails to emphasize the practical value of a knowledge of forms. Thus, "If a man be acquainted with the cause of any nature (as whiteness or heat) in certain subjects only, his knowledge is imperfect; and if he be able to superinduce an effect on certain substances only (of those susceptible of such effect), his power is in like manner imperfect. Now, if a man's knowledge be confined to the efficient and material causes which convey the form in certain cases) he may arrive at new discoveries in reference to substances in some degree similar to one another, and selected beforehand; but he does not touch the deeper boundaries of things. But whosoever is acquainted with

[22] T. Fowler, *Bacon*, 1881, p. 113.

Forms, embraces the unity of nature in substances the most unlike; and is able therefore to detect and bring to light things never yet done, and such as neither the vicissitudes of nature, nor industry in experimenting, nor accident itself, would ever have brought into act, and which would never have occurred to the thought of man. From the discovery of Forms, therefore, results truth in speculation and freedom in operation." [23] Again, "So then always that knowledge is worthiest which least burdens the intellect with multiplicity; and this appears to be metaphysic, as that which considers chiefly the simple forms of things (which I have above termed *forms of the first class*); since, although few in number, yet in their commensurations and coördinations they make all this variety. The second respect which ennobles this part of Metaphysic, is that it enfranchises the power of men to the greatest liberty, and leads it to the widest and most extensive field of operation. For Physic carries men in narrow and restrained ways, imitating the ordinary flexuous courses of Nature. . . . But whosoever knows any Form, knows also the utmost possibility of superinducing that nature upon every variety of matter, and so is less restrained and tied in operation, either to the basis of the matter or to the condition of the efficient." [24]

To us it appears very doubtful if a knowledge of forms has the practical value which Bacon claims for it. Can I produce whiteness more readily if I know the form of whiteness than if I know only certain efficient causes of whiteness? Assuredly not. The form of whiteness is the principle of corpuscular structure upon which whiteness depends, and to say, "Produce whiteness by producing the form of whiteness," is practically the same as saying, "Produce whiteness by producing it." Nor does Bacon suffi-

[23] *Nov. Org.* II, 3.

[24] *De Aug. Sc.* III, 4, pp. 470f-471 of J. M. Robertson's edition (already cited) of Bacon's philosophical works. Cf. *Nov. Org.* II, 4 and 17; *Valerius Terminus, passim.*

ciently recognize the impossibility, perhaps, of superinducing form or forms on any concrete body. Though we know the form of whiteness, not every body is capable of receiving such form. Though we know the forms of all the simple natures found in gold, it is probably much more difficult than Bacon reckoned,[25] perhaps impossible, artificially to combine these forms in one body, i. e., to produce gold.

We have already seen how Bacon's induction must proceed by an exclusion of forms. But forms are notions. This admitted, a fallacy in argument makes itself manifest. "The Syllogism consists of propositions, propositions consist of words, words are symbols of notions. Therefore, if the notions themselves (which is the root of the matter) are confused and over-hastily abstracted from the facts, there can be no firmness in the superstructure. Our only hope therefore lies in a true induction." [26] Bacon argues in a circle. Induction, he says, is exclusion of forms and, also, induction is accurate definition of forms. The same fallacy is seen in *Nov. Org.* II, 19, " In the process of exclusion are laid the foundations of true Induction, which, however, is not completed till it arrives at an Affirmative. Nor is the exclusive part itself at all complete, nor indeed can it possibly be so at first. For exclusion is evidently the rejection of simple natures; and if we do not yet possess sound and true notions of simple natures, how can the process of exclusion be made accurate? Now, some of the above-mentioned notions (as that of the nature of the elements, of the nature of heavenly bodies, or rarity) are vague and ill-defined. I, therefore, well knowing and nowise forgetting how great a work I am about (viz. that of rendering the human understanding a match for things and nature), do not rest satisfied with the precepts I have laid down; but proceed further to devise and supply more powerful aids for the use of the understanding; which I

[25] See *Nov. Org.* II, 5.
[26] *Nov. Org.* I, 14.

shall now subjoin." [27] This passage can be paraphrased briefly thus—induction is exclusion of simple natures and induction is accurate definition of simple natures.[28]

Induction as exclusion or as definition Bacon found impossible of achievement. It does not seem possible at any time to divide nature into a fixed number of simple natures and forms, as exclusion requires. Knowledge is dynamic and further simple natures and forms may be discovered. Bacon himself, perhaps, implicitly recognized this possibility. "And now it is time for me to propound the art itself of interpreting nature; in which, although I conceive that I have given true and most useful precepts, yet I do not say either that it is absolutely necessary (as if nothing could be done without it) *or that it is perfect.*" [29] The future may see a change in even the method of discovery. "It is true, however, that by my precepts everything will be in more readiness, and much more sure. Nor again do I mean to say that no improvement can be made upon these. On the contrary, I that regard the mind not only in its own faculties, but in its connection with things, must needs hold that *the art of discovery may advance as discoveries advance.*" [30] Nor did Bacon ever succeed in defining accurately either simple natures or forms.

Simple natures and forms are "constant and eternal and universal";[31] definition appears to be the reverse. Consider, for example, the simple nature, heat. To define heat, it is necessary to examine different instances of heat. But there will be instances which some will admit as instances of heat and others exclude. Thus, Bacon in *Nov. Org.* II, 11, where he makes a presentation of instances agreeing in the nature of heat, notes that "strong oil of sulphur and of vitriol has the effect of heat in burning linen"; to which

[27] *Nov. Org.* II, 19.
[28] For "simple natures" we would substitute "forms," as previously shown.
[29] *Nov. Org.* I, 130. Italics mine.
[30] *Ibid.* I, 130. Italics mine.
[31] *Ibid.* II, 5.

instance Fowler gives this footnote, "Of the substances alluded to in this and some of the following examples, Sir John Herschel (*Discourse on the Study of Natural Philosophy,* para. 345), remarks that they 'excite in our organs, and especially in that of taste, a sensation of heat which they owe to their being chemical stimulants, and not at all to their being actually hot'." [32] The definition of heat, therefore, will vary in accordance with the instances of heat admitted or excluded. Is knowledge in general capable of discovering anything "constant and eternal and universal?"

Bacon himself seems to have recognized difficulties attaching to his method of exclusions, for we find him latterly laying greater stress on the inductive value of Natural History, i. e., the collection of the concrete facts of nature.

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[32] *Nov. Org.*, ed. by T. Fowler, 1878, p. 357, note 65.

PHILOSOPHY AND THE SYNTHESIS OF KNOWLEDGE

THE future of philosophy may be said to be promising precisely because there never was quite so much doubt whether philosophy has any future at all. Men are more or less aware that the older spiritual concepts have become ineffective, and that we are in need, in view of this condition, of some appealing, trustworthy ideal of life. They are more or less conscious, too, of the difficulty presented by the vast accumulation and specialization of knowledge, the difficulty of synthesizing what is known into an adequate world-view. These facts, while they have led to philosophical scepticism more wide-spread than we are apt to realize, have acted as a challenge to philosophers, arousing them to unusual activity and earnestness.

One of the most pertinent recent reviews of the function of philosophy under present conditions is that of R. F. A. Hoernlé, in his *Studies in Contemporary Metaphysics.* Mr. Hoernlé's position has direct reference to the charge that philosophy has become barren, has lost touch with the vital problems and perplexities of our age. He aims at an appraisal of philosophy as such. "Is anything, after all, being achieved by all this brilliant thinking and vigorous arguing?" He is attentive to the vastness and complexness of accumulated knowledge and "the instability of the existing order, the uncertainty of the future, the perplexing practical problems which beset mankind on every side." It is this situation, "when the war has thrown the old order

into the melting-pot; when the traditional relationships between classes and nations, and the beliefs by which these relationships were sustained and approved, are rapidly being dissolved; when vast changes are in process the drift of which no man can foresee and none claim to be able to guide assuredly to a wise and happy issue"— it is this situation which leads Mr. Hoernlé to ask, "Is the whole enterprise of philosophy at bottom really worth while?"

What can a philosopher, thus out of humor with philosophy, do to reassure himself? "He must recall to himself," says Mr. Hoernlé, "he must try to communicate to others, what philosophy is like as an experience dominating his life, as an absorbing occupation, as a concentration in intense activity of his whole being. What is wanted is not some definition of philosophy, not some catalogue of problems, or drawing of boundary-lines around its subject-matter, not comparisons with science, religion, poetry. These touch the fringes, not the heart of the matter." (p. 9.)[1] In other words, he must attain to an experience, not merely arrive at a definition. Let us stop asking, What is philosophy? Let us ask, What is it to philosophise? What we have to understand is "the spirit of philosophy as it is experienced by the thinkers engaged in philosophising." (p. 10.) It is this spirit, rather than any special doctrines or systematic results of it, which Mr. Hoernlé proposes to render. "Let systems and results be as different as they may: there is an acknowledged kinship of philosophers in the spirit of their enterprise. This spirit is open to recognition in the writings of philosophers; it forms the common ground in all philosophical discussions. It introduces the individual thinker into a fellowship, a company, a communion of men engaged in the same endeavor though they may disagree about its very scope and method." (p. 10.)

Now what is this "spirit of philosophising"? Mr.

[1] All references, unless otherwise noted, are to Mr. Hoernlé's *Studies in Contemporary Metaphysics.*

Hoernlé answers the question with commendable directness. "That spirit is the spirit of wholeness. To philosophise is to seek an attitude towards the universe as a whole, or, in so far as the search at all succeeds, to have such an attitude." (p. 11.)

"Spirit of wholeness," "attitude towards the universe as a whole,"— such phrases are unfortunately most vague and ambiguous. Does the wholeness characterize the thinking subject or the object of his thought? Is it a quality of the "spirit" and "attitude," or of that toward which the spirit is directed and the attitude is taken? True, Mr. Hoernlé himself raises the question of its meaning, and discusses it at length. But the ambiguity is not entirely removed. And it happens that this question, namely, in what sense the philosopher can still lay claim to wholeness of knowledge about the universe and life, is just at present crucial. It is therefore worth while to discover what is meant by one who in spite of, nay because of, conditions which lead many to believe that philosophy, in the classic sense, is no longer possible, defends the philosopher in his claim to "offer a profounder and more comprehensive insight into the nature of the universe than any other mode of thought." (p. 7.) What, then, does "spirit of wholeness" mean?

The spirit of wholeness, says Mr. Hoernlé, "cannot mean obviously, that the whole of the universe in any quantitative sense is present to the thinker. Quantitatively, no finite mind can exhaust the universe. No accumulation of experiences would bring us appreciably nearer exhausting the inexhaustible." (p. 11.) There is the past of which we get only a sketchy return, the future of which we know nothing at all, and the immensity of the present reaching infinitely beyond our range of experience. What we can "effectively grasp of the universe by detailed exploration is but a fragment, a sample, a cross-section." (p. 11.)

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Whatever Mr. Hoernlé may mean, no one can justly accuse him of meaning that any man can directly experience the whole universe or explore its immensity in detail. "Wholeness," he says, "is not to be understood quantitatively, but qualitatively." (p. 11.) The spirit of philosophising must not be misunderstood to be the spirit of *quantitative* wholeness; it is the spirit of *qualitative* wholeness. It remains to make clear to ourselves just what this distinction between qualitative and quantitative wholeness signifies. If this can be done, we shall be in a position to decide whether the distinction amounts to a discovery or an expedient; whether by means of it the philosopher is actually able still to perform his old-time function of co-ordinating all knowledge in the interest of the conduct of life, or whether it merely enables certain philosophers to escape the predicament involved in claiming supremacy as knowers under conditions which make the claim difficult to defend and impossible to validate. That is to say, we shall be in a position to appreciate the conflicting currents of contemporary philosophy and to gain some conviction as to the direction philosophic development must take if it is to play a vital rôle in life.

Mr. Hoernlé rejects mastery of the sum of the universe's details as the ideal of the philosopher (an ideal which one wonders whether anyone in his senses could entertain); does he intend the opposite extreme? Does spirit of wholeness mean wholeness of spirit? Does qualitative wholeness have reference to the philosopher's state of mind? Does it mean that no matter how chaotic, complicated, and harassing the facts of life may be, the philosopher possesses his spirit in peace, is captain of his soul? Yes and no. The philosophic spirit does imply an "inward unity and reconciliation" (p. 22), "harmony with oneself," "stability in thought and feeling and action" (p. 23); it does mean "an habitual attitude or disposition of response;

a power to meet and master whatever comes—elastic, adaptable, resourceful, yet steadfast, intrepid, unshaken." (p. 23.) This inner wholeness, however, is merely the reflection, or counterpart, of an outer wholeness. The philosophic peace of mind "comes with understanding even if in the end it surpasses understanding." (p. 23.) The "spirit of selflessness" with which the philosopher meets "the fret and stress of practical life" is due to "occupation with eternal truths" (p. 21); his "self-adjusting equilibrium" is the result of "insight into the true value of things, which in the greatest becomes the very spirit of their living." (p. 23.)

But we need not base our conclusion upon a deduction from these fragments. Mr. Hoernlé makes the matter quite plain. "This account of the spirit of philosophy," he says (p. 16), "may provoke the contention that wholeness is predicable, not of the universe as a fact, but only of the philosopher's point of view as an aspiration; . . . that it is subjective and psychological, not objective and metaphysical; an intellectual demand or ideal, not an actual, or at least not a verifiable, character of the nature of things." To this Mr. Hoernlé replies that "no unity of mental attitude which is not supported by the facts, which is not rooted in the nature of things, will do. Unless the universe is a whole, it is meaningless to talk of seeking an attitude towards it as a whole. The 'point of view of the whole' is not an idle phrase. It means that the conviction of the wholeness of the universe is a lesson of experience, is taught us by the logic of the facts. It claims that experiences, drawn together by reflection, focused so as to interpret each other and thus reveal their common and total meaning, supply the evidence which justifies the conviction of unity and order" (p, 18).

We must now discover what qualitative wholeness, applied to the universe, means. "It consists, at the least,"

says Mr. Hoernlé, "in that quality of *organization* in virtue of which alone we can say that we experience a 'universe' or live in a 'world' . . . It rests on the fundamental fact which everyone can verify for himself, that experiences are not isolated and disconnected but expand and modify each other. Each illuminates others, gives meaning to them, derives meaning from them." (pp. 11-12.) In our babyhood (if I may venture to elaborate the point a little) we experience only showers of sensations and images as disparate as raindrops, interspersed perhaps with stretches of dull or luminous vacuity. Gradually, however, memory and anticipation are born, uniting experiences in time. And things soon take on the character of the togetherness we later call space. Little by little we are able to perceive other relations as well. In this way larger and larger groups of related things become known to us, until we attain to the concepts 'world' and 'universe.' Thus, quite spontaneously and inevitably, Mr. Hoernlé would say, the "principle of wholeness" works in our lives, and the wholeness of the universe is brought to light.

In another way likewise. From early childhood on, we learn by experience. Were this not the case, intelligent belief, volition, conduct would be impossible. But "the principle of wholeness" is "most obviously manifest in all learning by experience" (p. 12), and therefore "in some degree is characteristic of every mind." (p. 11). It "belongs in a greater degree to co-operative achievements, like science, or society, in which many minds share." (p. 11.) All this prepares the way for philosophising. Philosophising is "nothing but the sustained attempt to elicit this lesson, to focus and concentrate experience systematically . . . and to state its message and its meaning in the form of coherent theory." (p. 13). Mr. Hoernlé puts the matter succinctly in a paragraph: "The spirit of philosophy, then, as exhibited in philosophising, is the highest

form of the principle of wholeness which is present throughout the life of mind wherever something is being learned in, and from, experience. Philosophy thus is continuous with the rest of experience, as, indeed, it must be, if it is the effort to grasp reflectively its quintessence. At the same time, it has its specific character and is distinguished from other forms of experience in that it is the explicit, self-conscious, and therefore completest form of the operation of the principle of wholeness. For it is at least the aim of philosophical theory to satisfy that principle most fully, alike in comprehensiveness and in systematization." (pp. 13-14.)

All of which is clear sailing so long as a troublesome fact remains submerged. "Wholeness" of knowledge involves knowledge of parts. Every act of organizing presupposes awareness of the elements organized. It would not be hailed as a sign of extraordinary wisdom in a man if he admitted his general ignorance of muscles and bones and bodily organs but claimed to have grasped reflectively the quintessence of anatomy; or if he confessed his unfamiliarity with the structure and function of all specific machines, but announced himself possessed of a comprehensive, unified knowledge of machinery as such. The reason is that in these and similar cases the claim would be made in a field where we are sufficiently at home to judge of the validity of the claim. But the philosopher, taking as his subject the wholeness of the whole, so obviously sails beyond our horizon that we recognize our inability to judge whether his report is of an actual landscape or a cloud bank in the sky. It is, however, as true in the one case as in the other that wholeness of knowledge involves knowledge of units. Wherever unification of knowledge is attained it is obviously with reference to certain facts or experiences. It is these which are unified. If a plain man or an expert, if a farmer or a plumber,

a scientist or a theologian, an artist or an engineer may be said to have arrived at the quality of wholeness it is because he is so well acquainted with facts in his field of operation that he is able to see them in their bearing on each other, see them as a whole. In the same way if philosophising is "the explicit, self-conscious, and therefore completest operation of the principle of wholeness," the philosopher must, more than any other thinker, be master of the world of facts and experiences. Only then can he perceive their mutual inter-relation. In other words, unless "qualitative wholeness" is to be no more than a mystic phrase, capable of inducing a large emotion, it must presuppose acquaintance with significant details. Either the wholeness arrived at by the philosopher is a mere feeling of his own, not an insight into reality at all, or the supreme thinker must assume the responsibilities of his pretentions.

True, a neat defense has been built up against this attack. We are told that philosophers do not pretend to supersede specialized investigation; they co-operate with it. They leave it to investigators in special fields to deal with facts in their raw state and reserve for themselves the task of taking the systematic results of these first-hand contacts and fashioning them into one comprehensive whole. They concern themselves with the "gist" of the sciences, the "essence" of religion, the "soul" of art, the "principle" of this or that or the other thing. In harmony with this spirit Mr. Hoernlé says that "the data and materials for philosophical reflection . . . are not the crude and chaotic experiences of immature minds, but the already highly organized systems of experience in which mature minds participate through their feelings, thoughts, and actions. We must have art, science, religion, social and political life, and all these in various degrees and forms, before a situation can arise in which the need for philosophising in the proper sense is felt; before the peculiar problems present

themselves which supply the persistent occasion and stimulus for philosophising." (p. 14.) These problems "arise from the contradictions and conflicts between these several types of experience, or within each of them," and the effort of philosophical reflection is directed, first, "upon eliciting the essence, or real nature, of each type of experience, by grading the examples of it so as to study those which exhibit the nature of each at its best, most fully, most characteristically" (p. 14), and second, upon discovering "a more comprehensive point of view, in which the divergent ways of thinking and acting may be brought together and adjusted so that unity, consistency, wholeness are recovered, or, rather are brought to light." (p. 16.) It is in this sense that "to philosophise is to seek to apprehend the universe as a whole, and to employ all the resources of experience in this task, taking each type of experience at its best, when its lesson is clearest, and learning most from those experiences which in range and organization emancipate us most from superficial first impressions and lead us deepest into the heart of reality." (p. 16.)

This sounds convincing. We are accustomed in every day life to receiving all kinds of information in digest form—why shouldn't the philosopher be able to squeeze out the essences of the various arts and sciences and distil a philosophic wine in which all known truth is perfectly blended? But does the proposal bear examination? I think not. If we drop metaphors (for "gist," "essence," "heart," "soul," are metaphors in this connection) and talk concretely, the proposition amounts to saying, first, that the philosopher can obtain in every field of knowledge and order of experience such acquaintance with facts and principles as will give him an insight into each subject which no omitted detail would amend if included; and, second, that he is able to combine these insights into one all-luminous vision in which each fact and principle is perfectly

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concatenated with all the rest. Let those believe the philosopher equal to this task who can; a number of considerations make it appear beyond his powers to me.

Of these considerations the more conspicuous has already been touched upon. In his address before the mathematics-physics section of the British Association, President G. H. Hardy spoke of the embarrassment inseparable from the obligation to address a group representing different sciences even when they are as closely related as mathematics, physics, and astronomy. Only two alternatives seemed open to him. He could take refuge, he said, in a series of general propositions, such as the value of scientific method, the need for better organization of scientific education and research, and other worn-out truisms. These matters he could discuss without undue strain on his honesty or his hearers' credulity. But in that case he felt he could hardly hope to increase any person's respect for the field of mathematics or for mathematicians. The only other alternative was, he thought, to say something about the one subject on which he had something to say. (*Nature*, 10:381ff.) The cause for this embarrassment, hinted at in these remarks, is made explicit in another recent presidential address, that of A. H. Brooks, before the Washington Academy of Science. "Berzelius" (the noted Swedish chemist who died in 1848), said Mr. Brooks, "is credited with the statement that he would probably be the last man who could know all chemistry, meaning thereby that the science had grown so large that it was becoming beyond the grasp of any single mind." "Since his day," continued Dr. Brooks, "the naturalist has been supplanted by the botanist, zoologist, ecologist, and geologist. These have given way to the taxonomist, pathologist, ecologist, glaciologist, and paleontologist, to name but a few of the present subdivisions of the older professions. The end is not in sight, for as science becomes more exact

a still higher degree of specialization is certain. Now a scientist may not even know the meaning of a word that describes the work of a professional college." (*Journal Wash. Acad. of Sci.*, 55:47 N. S.)

These thoroughly typical instances, taken at random, illustrate the attitude of men of science. It is admitted that the obstacles in the way of arriving at the "essentials" of knowledge in even a limited field, and by those best qualified through training and experience to do so, are practically insuperable.

But the situation is worse for the philosopher than appears from this reflection. There is the previous question whether the significance of a science or an art can in fact be arrived at from the outside; whether the man who has no immediate contact with a field of human endeavor can gain such acquaintance with its data, methods, and outlook as to enable him to express its essential meaning. I believe that few who weigh this question will answer it in the affirmative. We all recognize the fact that ignorance of the setting of a problem makes impossible a full appreciation of its significance. The conditions out of which the problem grew, the devious windings to which the search for its solution led, the happy turn by which at last the answer came in sight, these are some of the preliminaries which give the outcome its peculiar flavor. The whole significance of an investigation, and hence of a field of investigation, never gets itself stated on paper or otherwise. Such statements are highly simplified, and the reader simplifies the simplifications. If he is fortunate his understanding may not be actually false, but it will be inadequate; it will omit all manner of implications present to the one who knows what we commonly call the background. Only the man who experiences the warmth and intimacy of direct occupation with scientific, social, artistic, religious or other problems is in a position to sense the true inward-

ness of the field in which he is engaged. He, if anyone, might talk of arriving at the gist of the subject. He would probably smile at the thought of such a thing, aware as he is of the vastness and intricacy of the material involved and hence of the problem of reducing it to a few manageable formulas; yet he, if anyone, might aproach the requisite insight and approximate an adequate statement. The outsider gets at the skeleton, not the life of the subject. That is why learned disquisitions, though they be music to the disquisitors, often sound like the rattle of dead bones to those who have intimate knowledge.

Nor can Mr. Hoernlé object to this criticism. He makes this very point in various parts of his book. He raises the question, for example, whether philosophy as conceived by him is worth while, and answers: "Those who have devoted themselves to it have found it so; and they alone are in a position to judge. (p. 3.) Again, in reference to James' remark that "a man's vision is the great fact about him," he says: ". . . yes, and the vision includes the reasons which James says we do not care about. We cannot share the vision, unless we share, or supply ourselves, the reasoning which yields the vision." (p. 25.) Once more, in considering the validity of religion he insists that "the student of religion, if he is not to miss the heart of his subject, must himself be religious. To be religious, to know religion from within or by acquaintance, to know what it is to be religious by being it—these are ways of describing the prerequisite without which we may bluntly say that the student will not know what he is talking about. Without it, his thinking will not be, in Royce's phrase, 'from the life.' Without it, his knowledge will be an outsider's knowledge—knowledge *about* religion, not knowledge *of* it. Without it, he will be a helpless prey to the danger which besets all reflection—the danger of overdetachment

from its subject in the very effort to get a good look at it." (p. 301.)

I should not myself be quite so blunt. I should not go so far as to say that without intimate acquaintance from within a student necessarily "will not know what he is talking about." Indeed, if the position is taken strictly it amounts to sheer obscurantism. But I do urge that one who studies a subject at second hand cannot presume to speak with authority nor lay claim to have arrived at the "essence or real nature" which the subject in question has to contribute to a completely unified knowledge. On the other hand, I find myself compelled to go much farther than Mr. Hoernlé. I see no reason, as he does, for exempting the philosopher from the limitations which beset all other thinkers. The truth seems to me to be that inescapable superficiality is peculiarly the predicament of the philosophers who aim at the ultimate truth about the uinverse, "the *fullest* revelation of it, its *real* nature, its character as a *whole*," which "is displayed only in so far as its partial revelations [in concrete experiences, specialized disciplines, etc.], are brought together so as to supplement, correct, interpret each other." What they present to us is an impressionistic study notable chiefly for its distortion of familiar objects and the ingenuity of the artist; a study which may be impressive and noble if taken as an expression of the lyrical spirit, but stuff and rubbish if regarded as the most profound and comprehensive synthesis of extant knowledge. That the claim persists in spite of this is natural enough. Competent critics outside of philosophy are kept at a distance by the very audacity of the claim and the nubiferous character of philosophic discussion. If the critic has a sense of humor, he smiles and lets it go at that; if he hasn't, he is repelled by the philosopher's pretentions or awed into silence by the general air of unapproachable profundity. But were philosophy a game of poker this

conventional bid of the philosopher would have been called long ago.

Now suppose the philosopher stops this reckless overbidding of his hand; suppose he admits (in the words of E. H. Moore) that "you can say everything about nothing and nothing about everything," is his office deprived of all worth and dignity? Suppose he frankly recognizes the fact that the day is gone when a man might legitimately hope to synthesize what is known into one all-comprehending concept of reality, is there any vital function left for philosophy to perform? A very important one, as it seems to me. The philosopher may refuse to look upon specialists of all kinds—artists, scientists, theologians, etc.—as hod-carriers in the service of his ambition to build a metaphysical temple to house the ultimate truth without surrendering his purpose to participate worthily in the life of his time. He may make it his aim to arrive at a conception of the most comprehensive, thorough-going, and practicable inter-relation of the forces and purposes of life. Instead of seeking to discover a hidden, yet eternal, order in a disorder which, while somehow genuinely troublesome, is after all only apparent, he may aim at the achievment of the best possible adjustment of actual disorders in the interest of fullness of life.

It is possible to go farther and to say that this is what wholeness always turns out to be. It is always known as some active or projected organization of experience. Reading Mr. Hoernlé with this conception in mind, one finds him to express it excellently. I borrow this statement of the idea: "The development of knowledge," he says, "the growth of character, are illustrations of this principle of organization. When repeated observations of the same object, revealing its different qualities and modes of behavior under different conditions, yield comprehensive and systematic knowledge of it; when countless diverse facts

suggest and verify a theory which explains them; when practice brings skill in the execution of a movement; when habit brings economy of time and thought; when interests and purposes which might conflict are adjusted to each other on a scale of relative urgency and value, with much discipline of desires and feelings in the process, and careful control of conduct—the quality of wholeness is displayed" (p. 12). Exactly. Generalizing the principle, we can say that the philosopher may satisfy his demand for wholeness in the endeavor to project a vision of human life in which genuine diversity of interest, aim, and talent, and real diversity of experience may hope to find the maximum of coöperative functional unity.

In this respect, the reduction of their vision to a program of conduct, philosophers, I think, do not differ. The difference between them turns rather upon whether the program is supposed to be justified by insight into the ultimate wholeness of the universe; to reflect its final or real nature by eliciting the essence of each type of experience, as Mr. Hoernlé claims; or whether it intends to be no more than the most inclusive point of view, in which divergent ways of thinking and acting are brought together and adjusted. In my judgment, the former conception must be given up. Once a legitimate ideal, to insist upon it today tempts to sentimentalism and obscurantism, to the mere enjoyment of emotions which certain words have the capacity to arouse, after the realities they stood for have vanished. The latter conception, however, grows in significance in direct proportion to the need for unity and common understanding. Based upon the widest possible study of concrete fact it aims to present a comprehensive, appealing theory of human life, and to arouse interest in its realization. Perhaps the universe may in this way gain a "wholeness" which otherwise it would not have. But whether it does or does not, human life will gain in security, sanity, richness, beauty, and dignity.

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THE GROUP MIND AND THE GENERAL WILL

THE group-mind, and the problems which cluster round it, are commonly supposed to be more than a psychological fad or a piece of misty philosophy. These topics, in Maitland's view or in Gierke's—to say nothing of the *Contrat Social*—have an important place in political and in legal theory. On the other hand, there is no doubt whatever that a great deal of confusion and misunderstanding (to say nothing of split hairs) has coagulated round them, and it may not be unreasonable to suppose that most of the other mistakes might be avoided if the hairs were split systematically. Hair-splitting is confusing and exasperating only when it makes sudden irruptions, guerilla-wise. A methodical campaign of hair-splitting is neither confusing nor exasperating. It is far too laborious, and this is my excuse, if I have one, for writing this paper.

Being methodically minded, then, I propose to begin with the simplest possible case, and this is plainly the case where the group is the smallest possible and where the fewest assumptions are made concerning the connections of its members. In other words, the first instance to be considered is that of a group of two minds in which we assume only that they are gathered together or form a couple. It may be argued, no doubt, that this group is far too small even to touch the fringe of the really important questions which arise; but this contention has no health in it. To choose only one example, if Miss Follett's arguments are

suggest and verify a theory which explains them; when practice brings skill in the execution of a movement; when habit brings economy of time and thought; when interests and purposes which might conflict are adjusted to each other on a scale of relative urgency and value, with much discipline of desires and feelings in the process, and careful control of conduct—the quality of wholeness is displayed" (p. 12). Exactly. Generalizing the principle, we can say that the philosopher may satisfy his demand for wholeness in the endeavor to project a vision of human life in which genuine diversity of interest, aim, and talent, and real diversity of experience may hope to find the maximum of coöperative functional unity.

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sound they undoubtedly apply to a committee of two. It is more plausible, I admit, to object that the grouping is over-simplified when the members are regarded simply as an aggregate. Mr. Ernest Barker, for example, expressly maintains that there is *no* group mind when the minds are only an aggregate, but that otherwise there is or may be. Even on this showing, however, it would be necessary to consider a simple aggregate of minds in the first instance in order to point the contrast between this aggregate and the case, so momentously different, in which there is something more than simple aggregation. Our starting point, therefore, is clearly laid down.

In this simplest case, then, it is abundantly evident that we have no right to argue that a group *of* two minds is therefore *a* group-mind. To reason in this way is to commit the fallacy of composition. The most we are entitled to say is that there is a mental group, and this is not an inference for it is justified only if it is another way of saying that the members of the group are minds. This equivalent statement, then, tells us nothing new, and it need not be very illuminating. In point of fact it would not be illuminating to say that a group of two hatchets was a hatchetty group, or that a group composed of a hatchet and of a mind was either hatchetty-mental or mentally-hatchetty.

There can be no dispute here, provided that the minds which form the group are admitted to be units; but it may be mentioned in passing that some of the arguments which profess to deal with a group-mind forget this elementary consideration. A kindly or a witty or a red-haired pair, for example, means simply a pair whose members, taken severally, are kindly or witty or red-haired. Nothing more need be supposed.

The proviso, however, is a more serious business. It is a fundamental assumption of common sense (and therefore of legal theory) that the units which we call minds *are*

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units, if not in an indefeasible, at least in an exceptionally important sense. This fundamental assumption, however, is flouted, for various reasons, by sociologists like Durkheim or Lévy-Bruhl, by psychologists like Ribot, and by philosophers like Bosanquet or the Dean of St. Paul's. The simplest form of this denial is the one which cites the recorded instances of "dissociated personality" in order to show that minds—these natural units of common sense theory—are in reality highly divisible, and a slightly more complicated argument is that which attempts to prove its important conclusion by a tortuous perambulation round the humble worm. When a worm is divided into two, we are told, its mind is straightway divided into a pair of minds, and this with very little inconvenience to the worm. If the divided worm is united again, and heals, the two minds become literally unanimous once again—and all without realizing that anything surprising has happened. From the worm, then, this nimble vermiform argument leaps at once to mankind, and invites us to admit that all we can say upon oath about a man's mind is that it is some sort of aggregate of mental states.

If this were so, *every* mind would be or contain a large number of group-minds, for every mind would be simply an aggregate of mental states, and each of the possible permutations and combinations of the mental states which compose it would also be an aggregate, and therefore as good an aggregate, and therefore as good a mind, as the aggregate which we happen to call "a" mind. A couple of minds again, would contain all the possible aggregations of mental states which might be chosen indifferently from one mind or the other. A couple of "minds," therefore, would be or contain a *very* large number of group-minds.

Even the most ardent supporters of this argument would probably look for some limitations to this extreme form of it, but they would certainly challenge the common sense

position which maintains (in relatively precise language) that the mental states which, as we say, compose *my* mind have to one another a quite peculiar relation, enormously more important than any other, which none of them can have to any other state of any other mind; or, again, that nothing which is part of one self can ever be part of any other self. On this definition, minds are certainly units, but their unity is so very tight that it begs the whole question. To keep the argument going, in short, we have to assume both that an individual mind (as we call it) is a unit in *some* important sense—in other words that it is not *merely* an aggregate of mental phenomena—and also that it is not a unit in that indefeasible, question-begging sense which rules out the possibility in advance that any individual mind could also be part of a group-mind. Assuming this, then, we may now approach the more serious part of our task and consider whether two minds which *influence* one another form a group-mind.

It is clear, to begin with, that a fallacy of composition does not lose its sting simply because the units of the collection affect one another. The ancient, stock, example of the fallacy—the one, I mean, which calls attention to the strength of the bundle of sticks in comparison with the weakness of the separate sticks—derives its force, not simply from the fact that the bundle is an aggregate but principally from the fact that it is a pretty tough sort of bundle. Or again, let us return to our hatchets. If one of the hatchets were magnetized it might attract the other, but the two hatchets would not then become a group-hatchet. On the contrary, the group would not be a hatchet at all. For it would not cut.

Per contra, it *may* happen that two units, combining, form another unit of the same kind as the original ones. A drop of the fluid water, for example, uniting with a drop of the fluid methylated spirits, forms another drop of fluid—

a large drop, to be sure, but still a drop. And, again, two armies uniting together and coöperating may form another army, a larger army, but still an army.

There are certain advantages—perhaps considerable ones—in examining the difference between these two instances. In the first of them the original units do not retain their original individuality. In the second case, however, the two armies which unite may retain their characteristic individuality and *also* be part of the united army. Certain well-known controversies concerning unity of command may show, no doubt, that this sort of union is difficult; but it is not inconceivable.

Clearly, a group-mind, if there is one, must belong to the latter type and not to the former. As we have seen, there is no argument at all unless we are entitled to treat the individual mind—say Maguire's—as a unit in some important sense, and it is manifest that whatever unity Maguire's mind may have is a unity achieved and sustained *within* his social relationships. To be sure, we may play with the fancy of some mind out-Crusoeing Crusoe, spending its infancy as well as its maturity on a desert island, its baby thirst assuaged by machinery, its manhood sustained as well as such a super-anchorite's could be. We may be certain, however, that *Maguire* is not a secluded unit of this unhappy sort. Maguire was suckled and he went to school, and even when we think of his most private affairs —his responsibility to his own conscience or the way in which his heart knoweth its own bitterness—we should never dream of denying that his individuality is found *within* a social milieu, not outside it. It is no matter if many of his characteristics and of his variations differ profoundly from those of his fellows.

This being premised, it is our business to consider what requirements must be fulfilled if two things, uniting, form

a complex thing of the same kind as themselves, and yet, in doing so, retain their characteristic individuality.

These requirements are the following: Firstly, that the original units must be complex, and, secondly, *either* that the parts of each of the original units are capable of having the same characteristic relations to some part or parts of the other unit as they had *inter se* within the original unit, *or* that the original units may have to one another, in their union, the same relations as the parts of each of them have *inter se*. The first of these requisites is plainly necessary since the group could not be of the same kind as the units if *they* were essentially simple while *it* is manifestly complex. The second requirement explains the alternative ways in which two complex units may unite to form a third complex unit of the same type as themselves.

Is it possible then that a union of two minds could fulfill these requisites?

The first of them, pretty clearly, is fulfilled. Minds are, in fact, exceedingly complex. If it were not so, life would be a delightfully easy business, and although certain philosophers hold that the complexity which we seem to find within an individual mind is wholly dominated by the ultimate simplicity of its master-ego, it is by no means certain that these ego-ists are right.

As for the second requirement, we should hold, I think, that it might conceivably be fulfilled in one or other of its forms, so long, at least, as our argument keeps to very general ground. As we have seen, *some* definitions of mind would rule it out in advance, and, besides that, there are certain general arguments which would destroy the possibility. If a single mind, for example, must have a single brain, or a single body, or a single *sensorium*, then *cadit questio*. Astral physiology apart, there is no single group-brain, or group-body, or group-*sensorium*. A caligula may wish that a nation had just one neck to be severed at a

stroke; but this is mere wishing. On the other hand, no one can prove that a mind ineluctably requires this physiological support, and if these contentions be waived, the general possibility of a group-mind, in some significant sense, should be conceded, at least provisionally.

When we turn to the more special arguments in this affair, we can see at a glance that most of them are intended to show that the first alternative possibility of the second requirement is in fact fulfilled. When two minds influence one another in a genuinely mental way, we are told, there is always a tendency for the parts of them to come together and to form a group-mind. The reason for this opinion, nearly always, is very simply stated. It is, quite precisely, that in all such cases we are entitled to say of the group what we say of its members. The group, taken as a unity, tends to have a will of its own, aspirations of its own, opinions of its own, its own desires and purposes, and these are just the properties which characterize a mind. Therefore the group *is* a mind; for things which have the same properties belong to the same class.

It is plain that this reasoning would be conclusive if all the properties, or all the important ones, were the same in the two cases, and if the properties were assigned in the same sense to the group and to its members. I propose, then, to deal with these questions but in different ways. The point of exhaustiveness may be left to settle itself as the argument goes on. The precise meaning of the properties may be dealt with now. Before doing this, however, I should like to offer one pertinent, if parenthetical, reflexion. The arguments I am about to consider are, for the most part, good arguments if only they could be established, and therefore they should be separated very sharply from an exceedingly bad argument which is sometimes foisted upon them. This bad argument explains (with complete irrelevance) that when two things influence each other,

each becomes different from what it was before. Of course, it does, but what of it? *This* statement is about *each* mind, and *not* about the group-mind at all.

Let us keep, then, to the better arguments, and begin with a familiar one which runs as follows. It is said that if one member (of our committee of two) convinces the other, or if, after discussion, the two come to agree for any other cause, they are then of the same mind. The answer to this argument, however, is also quite simple. The two are not of the same group-mind. All that need be meant is that each of them comes to have a similar opinion.

There is an adequate reply to this answer, however. If this is all that *need* be meant, it is by no means all that, very frequently, *is* meant. There may be far more than similarity of opinion, for the meaning may be that each member, as we say, consciously identifies himself with the group, that each aims at the common good, and accepts an opinion, or even a compromise, just because it has the *cachet* of potential agreement.

Now if this "identification" of private opinion with public opinion, of private interest with the common weal, of personal with general ends, could be taken quite literally, there would be no way of evading the conclusion. The group-mind which has seemed possible on general grounds would have been proved to be necessary on particular grounds, and there would be nothing more to be said. If, on the other hand, the identification is not quite literal, and if this and the other statements made in arguments of this type must be understood to be elliptical or metaphorical the argument would not be conclusive.

Which is it then? To speak mildly and soberly, it appears possible, at least, that all the facts alleged in the argument might be adequately explained without supposing that there is such a thing as a group-mind. In these

cases, we might say, each member forms the idea of coöperation and each feels himself strengthened by his own recognition that the other party thinks, or professes to think, as he does. The alleged self-consciousness of the committee, in other words, may mean only that each member of the committee recognizes the agreement between the members and desires to act in accordance with it. This explanation, surely, seems adequate. I should say that it seems adequate all along the line, and if it is adequate, there is no need to seek any other explanation. An intemperate fecundity of hypotheses is not science, but its opposite.

It may be argued, no doubt, that we have here two alternative hypotheses, and therefore that we should be prepared to accept either. Such a statement, however, would be a palpable misstatement. We certainly mean, *at least,* that each member of the committee is conscious of the unanimity when each assents to a unanimous finding. This is not hypothesis, but fact; and, if there is no need of any further explanation, why seek one? Moreover, there are many good reasons against accepting the *additional* (not merely the *alternative*) existence of a group-mind. When one member of the committee persuades the other, he does not transfer any part of himself to the other. All that happens is that when the two communicate, the persuasive party gets the other party to see the facts in the same way as he does. This is all that occurs, and it is also a great deal, for it is the basis of many homely and commonplace but indisputable truths. You cannot force an opinion upon another man. You may threaten to shoot him, no doubt, unless he says that he agrees, but even this violent measure is not literally a transference of anything from you to him, and there is no difference in principle when the man, incredible as it may seem, attaches weight to his knowledge that the opinion is held by *you,* and that it would be a com-

tortable thing if the pair of you ceased to squabble over it.

The idea of a common will, it may be granted, is considerably more complicated than the consciousness of a common opinion, but there seems to be no good reason for doubting that it also, with pains and patience, can be interpreted along the lines of the foregoing analysis. In the fullest sense of the words, the members of the committee have a common will when each of them intentionally pursues a common end. This phrase, the common end, is itself ambiguous. If two people want the same thing they have, in a sense, not merely a common but also an identical end, and if they cannot both get it there is something very different from unanimity. Antony and Augustus both wanted the same thing, the same world empire. They did not agree, and Augustus won. Russia and Germany both wanted Constantinople. Again they did not agree. The common end, therefore, is seldom an identical end. Even if it is something that can be shared, like sunlight or the weather, it is usually a different part of the shareable commodity which is appropriated by the different parties, and when the end, as is usual, is not a possession but a pursuit, what is meant is rather the choice of different but congruent functions on the part of each pursuer. The most usual way of pursuing a common end is that in which each pursuer acts in such a way as to respect and to further the aims of the other as well as his own (the more consciously and conscientiously the better) and the extreme case is that in which one of the pursuers renounces everything that concerns himself *except* his capacity of helping the other (if both parties pursued these tactics we should have an unusual, though not an impossible conflict of generosities).

These additional complications, therefore, in the case of the common will for a common end (as it is called) do not compel us to abandon the principle of our former analysis. They call, quite simply, for a little more patience.

It is necessary, however, to consider certain further complications which arise. When we speak of the "will" we sometimes refer to definite particular acts of responsible choice, and sometimes we do not. In the former case—the case of express volition—it would seem that there is no need to amend the view above stated. Given a committee of two, it is true, no doubt, that it is correct to speak of the committee's decision and of the committee's responsibility. This joint decision, however, surely means, when it is argued out, that each member of our committee of two agrees to be a party to the decision, at least in the sense of acquiescing, and, in this simple case, the joint responsibility can only mean that each member accepts responsibility for the joint decision. Complications arise, to be sure, when one of the members dies or proves a traitor, but in principle some person or persons, according to some accepted arrangement, must shoulder the responsibility if there is any responsibility at all.

If, instead of this, we mean by a will a whole mass of dispositions and tendencies, rather vaguely defined and, for the most part, unconscious, we have quite obviously a different case. Indeed, it seems to be logically possible that even if there could not be a group-mind, or a group-person, there might, in this sense, be a general will. Rousseaus' *moi commun* might be a palpable fiction, his *volonté générale* an important, if a somewhat indefinite, reality. To maintain this view we should have to hold that a will is only a part of a person and that although persons cannot combine into a super-person, that part of a person which we call his will, especially if we define it vaguely as a set of tendencies, may unite with the will of another person in such a way as to give a conjoint set of tendencies which are, by definition, truly and properly a will.

This contention cannot be overthrown by the mere statement that it is only a matter of definition. The problem at

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issue—the possibility of a group mind—depends, in the end, entirely on what is meant by a mind. In other words, it *is* a matter of definition, and the only important proviso is that the definition should accurately describe what it sets out to describe. Accordingly, if a will (in the broader sense which is rightly distinguished from express volition) means *only* a system of tendencies to action of whatever sort, it is plain beyond disputing that these tendencies do unite when common action occurs, and that they supply a disposition towards common action even when the action does not occur. This fact is certainly a part, if not the chief part, of social capacity for united action for it means, quite simply, that there are, in fact, dispositions which tend towards united action, and even if these, in the general case, have to be reinforced by the conscious coöperation of each participant, this conscious decision is not the whole of the matter.

Indeed, it is possible (and sometimes plausible) to construct a host of arguments on grounds like this. Thus it is said, for example, that our lives are only a set of local manifestations of a General Life Force, that we are as mushrooms are in the eyes of a trained botanist, a set of sex-organs appearing sporadically above the surface but created and sustained by the knotted, intertwining tangle beneath. This simile, indeed, is almost ludicrously apt if it is taken to illustrate Jung's theory of the collective unconscious, and, seriously, if our unconscious willing is only the push and pull of rude unknown forces, there seems no good reason for denying that these forces belong in their essence to the collective unconscious, and that this is the explanation of social unanimity of thought and action. It is possible, too, that "dissociated personalities" may strengthen the argument. Our personality, we are told, may disintegrate, and this may mean that the collective unconscious, which commonly gives us the appearance of

being "one," sometimes, in sport, undoes its handiwork and makes us two or half a dozen.

Most of us, I suppose, consider these theories far-fetched and improbable. If so, we must examine ourselves and see whether we have any reason for this adverse verdict or whether, instead, we are the dupes of prejudice. Clearly, if we have a reason, we must have at least strong probabilities in favor of the view that our volitional tendencies as well as our express volitions are personal in the ordinary sense, that the collective mind is not personal in this sense (or at least that it is unnecessary to suppose so), and that there is no good reason for believing in the existence of any mind which is not personal (at any rate when it is taken to include experiences at the human level). Such arguments, to be sure, could not prove that a society of minds is not a unity, or that it is not a unity ineffably superior to unity which we call a mind; but if they were sound they *would* prove what they set out to prove—namely, that the so-called collective mind is not *a* mind at all.

In support of this view, very strong considerations may be urged. In the first place, the evidence from dissociated personality is not at all conclusive. Even if dissociation occurs (and it has not been proved to occur in the definitive, radical sense which is claimed for it) there is plainly an immense jump from the admission that a self (in very exceptional cases) may split into selves, to the doctrine that selves are always united into a super-self. All that would be proved would be that the thing might conceivably occur. There is no need to suppose that it does, in fact, occur (apart from further evidence). This further evidence, however, is astonishingly meagre. Even for devout believers in the unconscious, our "unconscious wills" are not simply sets of tendencies which might belong to anybody, or to everybody, or to nobody, quite readily and quite indifferently. For the Freudians, on the contrary, a

great part of these tendencies consist of personal experiences which have been repressed, and it is even claimed that we can trace the source of all nervous disorders to definite occurrences which can be proved to have belonged to individual infantile history. The collective unconscious, therefore, could only account for *the rest* of our volitional tendencies, and although there must *be* such a remnant (since the infant is not nothing when he begins his career) it is flatly absurd to deny that his initial tendencies may be personal, or to hold that this curious union between his wholly impersonal beginnings and his wholly personal history is at all a likely story. The balance of probability, in fact, is wholly in favor of the view that our unconscious tendencies as well as our conscious ones are very distinctively *ours*, and consequently that common sense, if not demonstrably right, is very probably so.

Up to the present, then, our discussion has indicated very strongly that the existence of any collective mind, if not flatly impossible, is at least extremely improbable. It remains to consider, therefore, whether there are any arguments, not hitherto mentioned, which upset this conclusion or weaken it appreciably. And here I must apologize. I cannot consider every possible view. On the other hand, I am bound to consider whether the restrictions I have put upon my argument seriously diminish its force. Apart from certain minor excursions, I have dealt, up to the present, with the smallest possible group—our committee of two. I pass now to the important question whether any appreciable difference is made when we consider a larger and more complicated group.

It is sometimes supposed, although falsely, that any increase in the complexity of these questions puts an end to the theory of a group-mind. If there were *any* group-mind, we are told, there would inevitably be far too many of them, and although these supposed difficulties might con-

ceivably arise even in the case of a committee of two, they are much more formidable when we are dealing with groups which are large in point of number and capable, being complex, of all sorts of cross-connections. Maguire, to revert to him, is a stout Catholic, a Fellow of the Royal Geographical Society, and a prominent member of the Free State Parliament. He therefore belongs to many groups (which are very mental indeed) and so, it would appear, he participates in many group-minds. I ask: Why not? If there is any group-mind at all which Maguire belongs to, it is clear that he (or the parts of him) must belong to two minds at least, his own and the group-mind. It is straining at a gnat to say that he cannot belong to more than two. These groups actually exist, do they not? Some may be more important than others, some spiritual and some merely temporal, some local and others world-wide. None the less, they all exist, and in that sense they do not conflict. In the same sense, therefore, these groups, if they were group-minds, might also exist all together. They may be at war, no doubt, but there may be war *within* our own minds (may there not?), and yet our minds exist.

Indeed, it is at least consistent to hold that one of the strongest objections to Rousseau's doctrine of the general will is the arbitrary limits which he sets to his doctrine. According to Rousseau, there is a *moi commun* only when every citizen has been (or may rightly be considered to have been) a party to a definite pact of union, and when this pact is of the highly special sort in which each citizen incorporates *the whole* of himself and his goods into *the whole* body politic. Anything less than this, Rosseau holds, or anything different from this, does not constitute a *moi commun* in any sense at all. There is no common self in any minor association like Maguire's scientific society, in any occumenical association like Maguire's church, or in any representative association like Maguire's Dail Eirann.

What is the logic of such a view even if we assent to Rousseau's distinction between the sovereign people and its delegated executive or government?

It would seem, however, that most of the believers in the group-mind would agree, on the whole, with Rousseau. At any rate, they would hold that there is *one* group-mind enormously more important than any other, and that *this* group-mind is the organized community (or the state). It is necessary, then, to consider this view in greater detail, and this discussion of it has at least one considerable advantage. It involves the consideration of the most important respects in which a large social body differs from a small committee.

Let us consider what an argument of this kind would have to prove. In the first place, since it is obvious that there are *some* differences between an individual and a social mind, it is necessary to show that these differences are, properly speaking, irrelevant. (We have seen already that this is not an easy task.) In the second place, it is necessary to *show,* also, that these relevant properties and relationships which are the same in the individual and in the social mind can *only* be found in the community taken as a whole—that is to say that they can *not* be found, say, in a church, or in a golfing union, or in an international confederation of workers. And this is very hard to establish.

Certainly, there are some specious arguments in the case. Among the "personal" characteristics which belong both to social groups and to individual minds the most important, probably, are the legal and moral ones of imputability, responsibility and ownership. Assuming this, it may be proper to argue that these terms, and others like them, cannot be applied at all to certain groups of minds, that they can only be applied in a subordinate and derivative sense to certain other groups, and that, in the full

sense, they apply to two cases only, the individual mind and the whole body of the people. A mere crowd, I suppose, is imputable, but it may be thoroughly irresponsible and it cannot own anything. A golf club may own property and may have certain responsibilities, but these powers are delegated to it by the community, and therefore have only a precarious parasitic standing. (This view, to be sure, may be disputed, perhaps with justice, but it is tenable.) The sovereign people, on the other hand, may be said to have an undivided and an underived responsibility, and to be the original fount of ownership.

So far as I can see, the essence of this argument turns upon the nature of undivided sovereignty and its implications. The individual mind, it is tacitly assumed possesses undivided responsibility towards itself, undivided sovereignty over itself. So does the sovereign people. And so does nothing else. Whatever is the bearer of responsible self-government is a person. Therefore the community and the individuals are persons, and nothing else is.

If this is the argument it is surely unconvincing. Every part of it is subject to the gravest objections, and the whole is not less objectionable. To begin with, we have the difficult question whether, in fact, either the individual or the society does possess undivided sovereignty over itself. Even apart from the most striking (but common) ways in which there may be a spiritual or a fleshy war within the man, it is clear that a man's sovereignty over himself is not unlimited. His powers of self-discipline and of self-control, as a matter of psychological fact, have a very narrow range although an extremely important one; and as regards one of the characteristics that come into the argument—the power of ownership—it would appear that the man's property depends upon organized convention in precisely the same sense as the golf club's. Is there not such a thing as conscription of a man's goods and labour

as well as of his body? The undivided sovereignty of society, again, is very difficult to believe in. If sovereignty *de facto* is in question, then it seems plain, in the first place that every sovereign does in fact bargain with other powers within it and outside it. The king bargained with the barons despite the theory of the feudal system. Our prime ministers, in war time and in peace time, bargain with trades' unions, and railways, and the labor bosses. Moreover, it seems equally plain that our states which are sovereign *de facto*—our swollen empires, our partitioned confederations with or without their corridors towards the sea—are conglomerations which depend as much upon chance and temporary convenience as upon anything else. Is it absurd for a Brahman, or for a darkey in Kentucky, or for a Russian Jew to maintain that there is *no* reigning power in the world to which he owes allegiance?

On the other hand, if we take ourselves to be speaking of the sovereign *de jure*, we are scarcely better off. Should it be a city-state as in Plato's dream, a canton as in Rousseau's ideal? Should it be a brotherhood of man or a theocracy which counts the earth as dross? There is no end to such riddles.

Secondly, even if these grave matters could be waived, it would still be open to anyone to argue that the church, say, was just as good a unit of ultimate sovereignty as any possible state. The essence of the distinction between the sovereignty of the state, and the authority of minor associations (local or professional or whatever they may be) is that the state, in principle, claims the whole of a man, and the others do not. It may be argued, indeed, that the state has no right to lay claim to any such limitless allegiance, even if *sometimes*, as in war, it is expedient for it to act as if the principle were true. A patient who puts himself in a surgeon's power during an operation emphatically does not admit that he is, in principle and always,

subject to the surgeon. Neglecting this, however, it may be admitted that if there is a fundamental distinction it is of this kind. Yet the church, too, if it sincerely believes that it is God's organization upon earth, claims *the whole* of a man's life, because *the whole* of a man is God's creature and vassal. Even an archangel, then, would not attempt to prove that there are *only* two soverign units, the man and the state.

Thirdly, and even more importantly, if all these objections were overcome, it would still be legitimate to argue that the "undivided sovereignty" of the social body meant only that each individual member within the social body tacitly or expressly admitted allegiance to the corporate group. In that case the members themselves would be the only bearers of sovereignty and our earlier arguments concerning the committee of two, its general will, and the rest, would also apply, without modification, to this larger, more complicated, and (perhaps) unique body. To avoid useless repetition I shall content myself with saying that it seems to me that these explanations are completely sufficient, and consequently that there is no good reason for believing in the existence of a group-self, or group-person, or group-mind, or group-will.

One further point in conclusion. It is sometimes maintained that these arguments, convincing as they may seem, fail at one critical point. They forget Time's part in these affairs. History and tradition show their nullity. The college remains although the masters and the fellows pass. England lives, although her sons cease to be. England's life, therefore (or the life of the college), is sometimes indefinitely greater than the lives of its members, and with this admission the case against the group-mind collapses.

Even if this argument were sound, we might be excused for doubting whether it proved that either England or the college was actually a mind or a person. It is needless to

pursue the point, however, since the argument is very far from being sound. Give the dead their rights and no argument remains. England *at present* is only a union of existing Englishmen who plan and remember and admit the fact. England, *past, present and to come,* is the union of past and present and future Englishmen. This is the whole of it, and it is enough.

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SPINOZA'S USE OF THE "EUCLIDEAN FORM" OF EXPOSITION

THE TIME which is marked with a revolt against authority and tradition, with an awakening of reflective thinking and careful criticism; the time in which the state—slowly but surely—takes the place of the church as an organ of civilization; with the striving toward equal rights and justice to all mankind; the time in which absolute lordship, slavery and serfdom gradually disappear is also marked by a revival of interest in nearly all branches of mathematics, science and philosophy. Great contributions are made to theoretical mathematics in algebra, theory of equations and trigonometry—as early as the last half of the sixteenth century, and in the beginning of the seventeenth century some new processes in geometry were invented. In applied mathematics, there seems to had been no progress, even up to the end of the sixteenth century, since the time of Archimedes. Statics and hydrostatics remained in much the same state in which he had left them, while a science of dynamics did not exist. It was then that Descartes developed a new system of geometry and Spinoza casts Descartes' and his own philosophy into a geometrical form.

Descartes' influence upon Spinoza in the field of metaphysics is a well-known fact, and it is reasonable to suppose that he exerted an influence upon him in the field of methodology. The monistic tendency of Descartes, which will be pointed out in another paper, and also the tentative

sketch in which a chain of philosophic reasoning is put into geometric form, may have been factors which have led Spinoza to adopt the geometrical form of reasoning. But on the other hand, the monistic tendency of Descartes does not necessarily lead to a form of rigorous logical reasoning such as that into which Euclid cast geometry. It does not presuppose that we must begin with a body of self-evident notions and by a chain of propositions, of which the latter are always dependent upon the former, are to build up a system of knowledge deduced from a few interrelated truisms. It is only in geometry that the system of space is a coherent one, while in Algebra, using the same method as geometry, we have apparently independent systems, i. e., an algebra of imaginary numbers, etc., of which each has its own truisms or assumptions. It is in algebra that we may ignore axioms, in fact assume contradictory ones and obtain what we normally designate as correct results.[1] We may use the axioms and yet obtain results contradictory to the axioms,[2] e. g., division by zero.[3] Descartes never

[1]
$$\begin{aligned} \text{Let } x - 1 &= 2 \\ x + 9 &= 2 \\ x^2 + 6x - 27 &= 2x - 6 \\ x^2 + 4x - 21 &= 0 \\ x - 3 &= 0 \\ x &= 3 \end{aligned}$$

[2]
$$\begin{aligned} \text{Let } x - 1 &= 2 \\ x^2 - 6x + 5 &= 2x - 10 \\ x^2 - 7x + 12 &= x - 3 \\ x - 4 &= 1 \\ x &= 5 \end{aligned}$$

(Axioms of algebra)
(a = b then a + 1 = b + 1)
(a = b then a − 1 = b − 1)
(a = b then a : 1 = b : 1)
(a = b then a . 1 = b . 1)

[3]
$$\begin{aligned} \text{Let } x &= 2 \\ \text{Let } y &= 2 \\ 13x &= 13y \\ 15x &= 15y \\ 13x + 15x &= 13y + 15y \\ 13x - 13y &= 15y - 15x \\ 13x\,(x - y) &= 15\,(y - x) \\ 13 &= -15 \end{aligned}$$

Axiom

Things equal to the same thing are equal to each other

$$\begin{array}{r} 7 \\ -2 \\ \hline 5 \end{array}$$

Axiom

The whole is greater than any of its parts, while in this case the whole is intermediate between each part

Ref. White's "Scrap Book of Mathematics."

thought of accepting the method of mathematics wholly as a method to be used in philosophy, he claimed only that by improving the mathematical method it could revolutionize philosophy and put it on a sound basis. As to Descartes' actual use of geometrical form,[4] it was only a tentative sketch in which he expressed his doubts as to its success.[5] Consequently we may conclude that the influence of Descartes upon Spinoza in the field of methodology—as has been said above—does not lie in the acceptance of the geometrical form into which Euclid cast the properties of space, nor in the improved method of algebra and geometry which Descartes employed, but in the misinterpreted method of Descartes, that is, the purely deductive method of algebra and geometry.

A contemporary of Descartes, Thomas Hobbes, exerted a great influence upon Spinoza. The marked influence of Hobbes upon Spinoza is shown in his treatment of political and social theory, and no doubt he was influenced by Hobbes as to the place of geometry among the sciences. Hobbes accepts the new natural science of Copernicus and Galileo,[6] whom he regards as the founders of science. Geometry is the only sure and universal discipline, all knowledge of reality is rooted in it.[7] Although Spinoza makes no direct reference to Hobbes in this connection, nevertheless, being familiar with Hobbes' writings, he must have been influenced by his conception of mathematics.

The certainty and simplicity of theorems in pure mathematics, the belief of Descartes and Hobbes in the universality of mathematics; all these considerations were important factors in convincing Spinoza that deduction is the only true method. But that does not answer the question

[4] From the reply to the second objection (Latin, 1670, p. 85-91).
[5] Preface to the *Principles of Descartes' Philosophy* (H. H. Britan, tr. 1905), p. 3.
[6] The beginning of *De Corpore*.
[7] *Elementa philosophica de cive* (Molesworth ed., vol. 1, ch. 1, p. 3).

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which we raised; what were the motives which prompted Spinoza to employ the form of deduction found in Euclid's text books?

From the end of the sixteenth century, there had been a gradual rise of interest in Euclidean Geometry in all parts of the world. In England, Roger Bacon said that toward the close of the thirteenth century the definitions and a few of the theorems in geometry were studied by some pupils of Oxford.[8] About 1570, Sir Henry Savile began to lecture at Oxford on Greek geometry, and in 1619, Briggs at Cambridge on Euclid. In 1665, Isaac Borrow, at Cambridge, prepared a complete edition of Euclid, while Gow says that "from 1660 to 1730 . . . was the period during which the study of Greek geometry was at its height."[9] The same is true of all other centers of learning in Europe. Euclid is the prime figure of interest. Just as Aristotle was the infallible authority of the middle ages, so Euclid was in the seventeenth and the beginning of the eighteenth century. At that time, we find Robert Simson saying,[10] in order to prove the infallibility of Euclid, that the mistakes in the proofs of the theorems found in Euclid's elements were not due to Euclid but to his translators. It must be remembered in this connection that a critical study of geometry was only begun in the latter part of the nineteenth century.

This great success of Euclidean geometry, and the first appearance of his elements in print at the time of Spinoza, must have had a magnetic influence upon the scholars of the day. But have we any reasons to believe that Spinoza himself looked upon the rigorous logical form of geometry as *the infallible type of reasoning?* Did the thoughts of Spinoza move in the fashion laid down by Euclid? Or are

[8] Ball, *Mathematics at Cambridge*, 1889, p. 3.
[9] Gow, *History of Greek Geometry*, 1884, p. 208.
[10] Simpson's, *First Addition of Euclid*. See also, Introduction to *Heath's Euclid*.

there any other reasons which would account for his use of the geometrical form? In order to answer this important query, let us examine the works of Spinoza.

The geometrical demonstration of the second part of the "Principles of Descartes' Philosophy," was written by Spinoza for a pupil whom he tutored, and it was only by the persuasion of some of his friends that Spinoza wrote the first part of the Principles, in order that both parts might be published. He permitted this to be published upon the condition that his friend, Ludwig Meyer, would explicitly state in the preface of the book that "he does not acknowledge all the opinions there set forth as his own inasmuch as he holds the exact contrary,"[11] but that it is only a faithful presentation of Descartes' philosophy. From the above facts we must admit that Spinoza did not employ the geometrical form of reasoning because he thought he could thus present an irrefragable body of truth. He did not use this form because of its infallibility. The proofs of Descartes' doctrines are as rigorous logically as his own in the Ethics, and yet Spinoza admits, at the time of the publication of the book that he holds the exact contrary of that proven in the Principles.[12] In fact, in the appendix to the book,[13] Spinoza gives his own views of God, not using the geometric method at all. Furthermore, in all of his other works, with the single exception of his Ethics, geometrical form of deduction is not employed, and even in the Ethics it is a very common thing to notice that Spinoza takes relief in an elaborate note in order to get away from the geometrical frame—e. g., the appendix to Part Four—and as a matter of fact, Spinoza is at his best in

[11] Spinoza to Oldenburg (Letter IX, Elwes tr.).

[12] The difference bewteen Spinoza's axioms and definitions and Descartes', does not wholly account for Spinoza's disagreement with some of the fundamental doctrines of Descartes. Spinoza does accept some of Descartes' axioms but does not always accept the theorems which he has proven in the *Principles of Descartes* to follow from them, e. g., in the demonstration of prop. 21, part I.

[13] *Cognitata Metaphysica.*

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these notes. The reader of the fourth part of his Ethics can not help but be conscious that the form in which the material is cast is bothersome and superficial; as Spinoza himself often says, such-and-such is self-evident, and really can be taken as axiomatic, but nevertheless he goes on and proves its validity by using the rigorous deductive method.

How can we reconcile the fact that Spinoza applied the geometrical method to error as well as to truth, to doctrines which were directly opposed to his belief as well as to principles which he firmly believed? Why were his friends so anxious for the publication of the "Principles of Descartes' Philosophy"? If he thought the geometrical method is infallible, why did he not employ it in his other books?

As has been pointed out, his first use of this method was in order to instruct a pupil of his in the principles of Descartes' philosophy. His aim was to put before the boy the simplest and clearest possible exposition of Descartes. It was a pedagogical aim, and not a philosophical one, which prompted Spinoza to use the geometrical form, in order that the pupil whom he was instructing might more easily comprehend the principles which Descartes developed and not the truth or falsity of his conclusion. *This method was not employed as a method of proof but for its pedagogical advantages.* The logical coherence of geometrical reasoning was the best from a pedagogical standpoint because of its conformity to the demands of the thinking mind, especially for the facility it offers for reviewing the bases of any theorem.

In the age where geometrical reasoning was at its highest, the appearance of the philosophy of the most respected thinker, Descartes, in the geometrical form was of very great advantage. All learned men were discussing geometry, and the casting of philosophy into a geometrical form would add greatly to the understanding of it. So we find Spinoza urged by his friends to publish the Principles of

Descartes' Philosophy." As Ludwig Meyer states in the preface, "granted, however, that truth may be established beyond all chance of doubt by these two methods [speaking of Descartes' method of reflective induction or inference and deduction] still they do not have equal value, for many plainly unlearned in mathematical knowledge and so wholly ignorant of the method by which such truth is discovered [first part of Descartes' method[14]] and by which it is set in order [second part of Descartes' method] are not only unable to teach the truth to others, but are unable to follow it for themselves. Whence it happens that many who have made his opinions and dogmas only a matter of memory, carried away by some thoughtless attack or influenced by the authority of others, have defamed the name of Descartes, and when a discussion of these things arises, since they cannot demonstrate anything, garrulously repeat what has always been ascribed to the Peripatetic Philosophy. Wherefore, in order that this state of affairs might be improved, I have often desired that some one . . . may remold in synthetic order the 'philosophy of Descartes' and demonstrate it in the more familiar form of geometry." [15] With this interpretation of Spinoza's use of geometrical form, the apparent discrepancy between the method employed and his own views upon some of the fundamental conclusions of Descartes' philosophy disappear.

Also, it becomes clear why Spinoza did not employ the geometrical mode of procedure in all of his books. And it also becomes clear why he did employ it in his Ethics. The Ethics was written in a geometrical form for the same reasons that his first book had been written. His last book presented his constructive philosophy and he felt it important that it be not misunderstood as Descartes' philosophy

[14] Concerning the fact that Descartes method consists of two parts, which will be pointed out in another paper.

[15] Preface to the *Principles of Descartes' Philosophy*, H. H. Britan tr., 1905, p. 3 and 4.

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had been. Consequently, in spite of a certain antipathy pointed out above, he put his last work in a form in which it could be most easily and clearly understood. Spinoza's thought, however, did not move in the fashion in which the material in the book is presented, as is now clearly evident. For Spinoza, truth is not geometrical, but rational; the proof of it is that of ground and consequence, cause and effect. "The knowledge of an effect depends on and involves the knowledge of a cause." [16]

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[16] Ethica, Axiom 4. A similar case in the history of science is found in Newton's employment of geometrical proof to cover up his results which he has obtained by the method of fluxiona calculus, because his critics would not understand this new method and would fail to realize its truth. "He accordingly cast the *Principles* into geometrical form, and thus presented it to the world in a language which all men could then understand." Ball's *A Short History of Mathematics*, p. 266.

Spinoza's Ethics appeared in 1677, while Newton's Principles was published in 1686. Both of these men writing about the same time found it expedient to present their important contributions in the geometrical form.

Referring to Euclid's arrangement of geometrical theories, Mach says: "For the purpose of instruction, the simplest principles, those most easily gained and apparently free from doubt and contradiction, are placed at the beginning, and the remainder based upon them." Mach, *Space and Geometry*, p. 112, McCormack tr.

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